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Kikuta et al.

(10) **Patent No.: US 6,564,775 B1**
(45) **Date of Patent: May 20, 2003**

(54) **FUEL DELIVERY PIPES**

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(73) Assignee: **Aisan Kogyo Kabushiki Kaisha**, Obu (JP)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/631,829**

(22) Filed: **Aug. 3, 2000**

(30) **Foreign Application Priority Data**

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Mar. 24, 2000 (JP) 2000-084996
Apr. 4, 2000 (JP) 2000-102703

(51) **Int. Cl.**[7] **F02M 41/00**
(52) **U.S. Cl.** **123/456**; 123/468; 439/130
(58) **Field of Search** 123/468, 469, 123/470, 456; 439/130, 79, 80, 76

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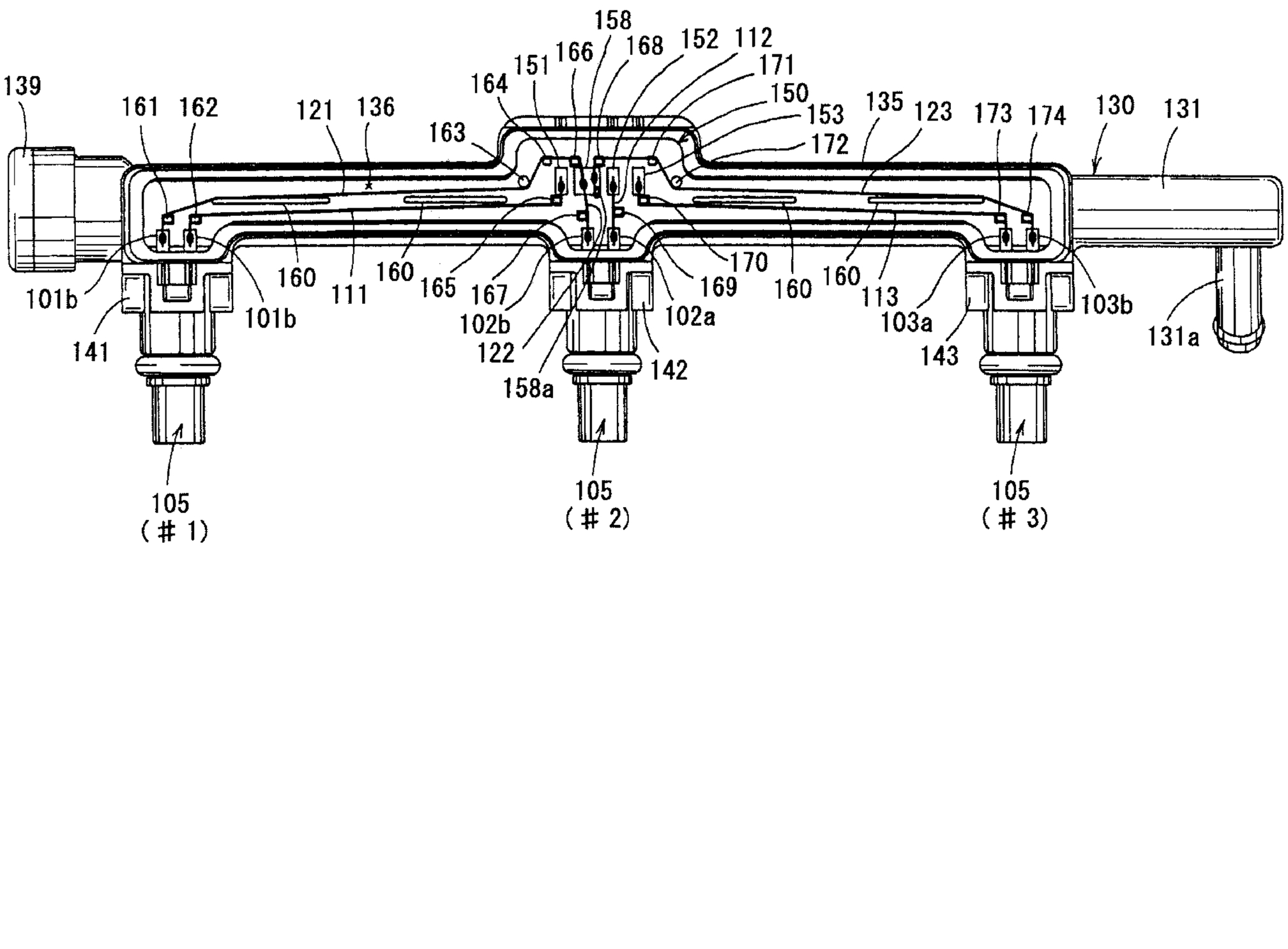
Primary Examiner—Carl S. Miller
(74) *Attorney, Agent, or Firm*—Dennison, Schultz & Dougherty

(57) **ABSTRACT**

Injectors **105** (**#1** to **#3**) are connected to a connector block body **130** and an external wiring connector **150** is formed on the connector block body **130**. The external wiring connector **150** has external wiring independent connecting terminals **151** to **153** and an external wiring common connecting terminal **158**. Wires are wound around wiring guides **158***a*, **161, 162, 165** to **170, 173, 174** and are hooked on wiring guides **163, 164, 171, 172**, which wiring guides are provided in the connector block body **130**. Wires **111** to **113 121** to **123** are installed without crossing each other between injector connecting terminals **101***a*, **102***a*, **103***a*, **101***b*, **102***b*, **103***b* of the injectors **105** and external wiring connecting terminals **151** to **153**, **158**.

28 Claims, 27 Drawing Sheets



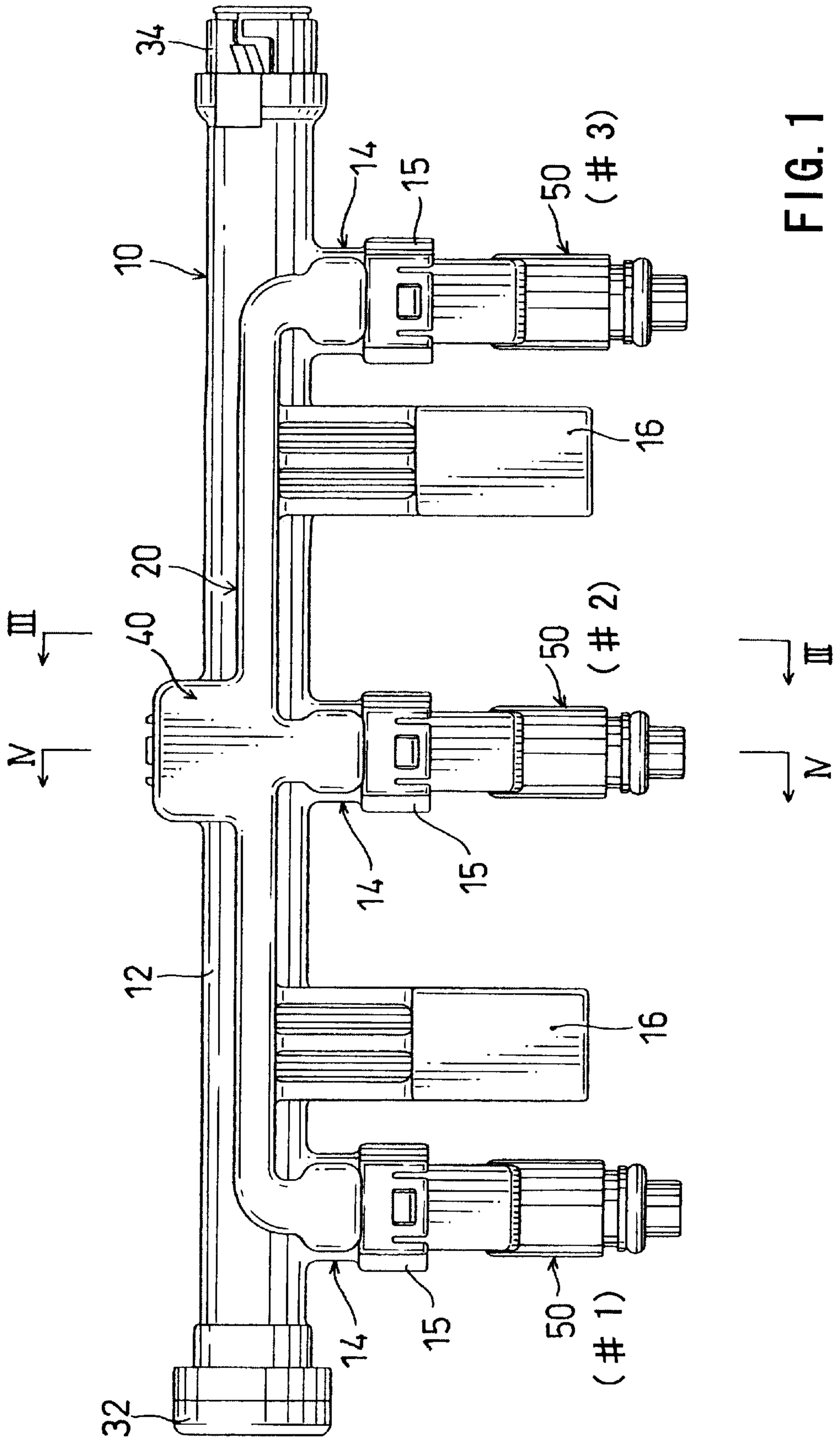


FIG. 1

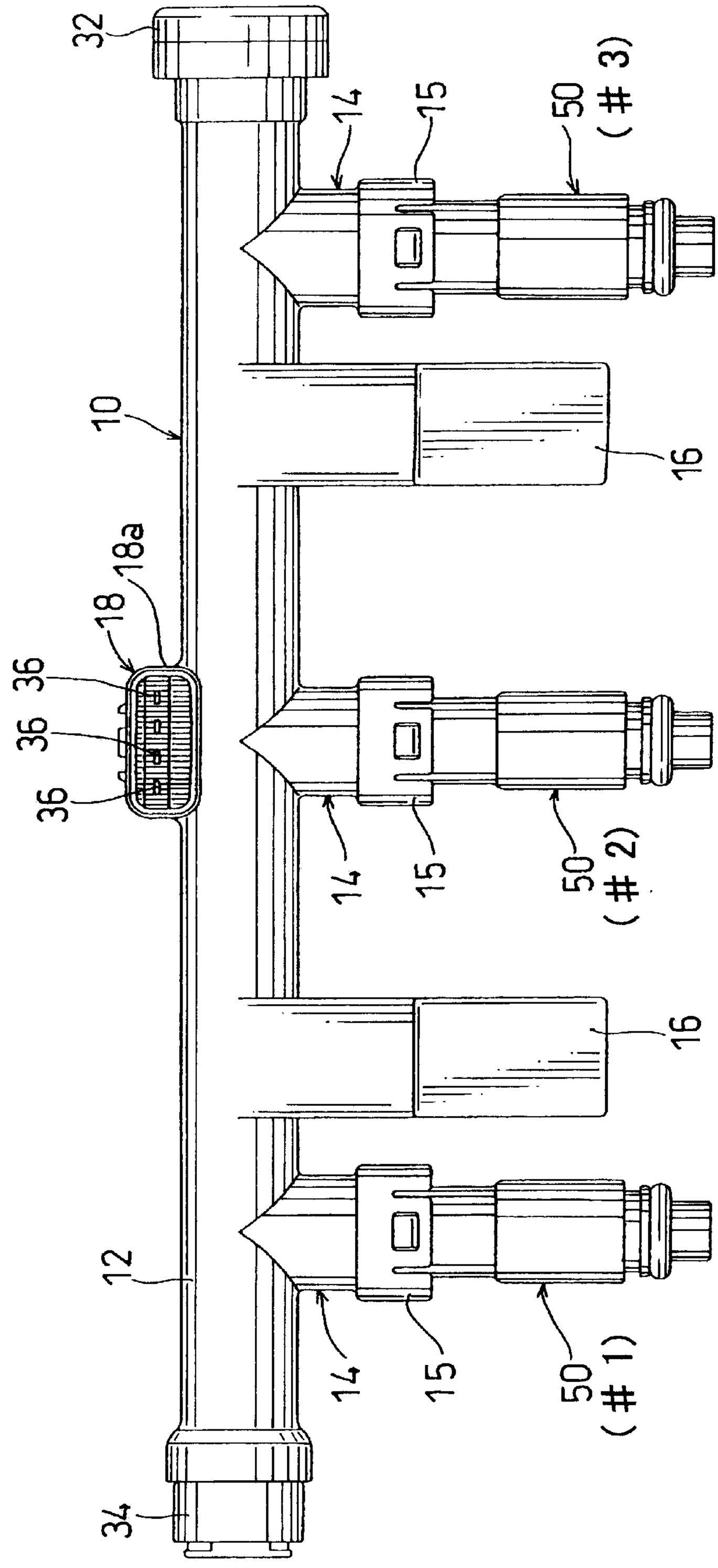


FIG. 2

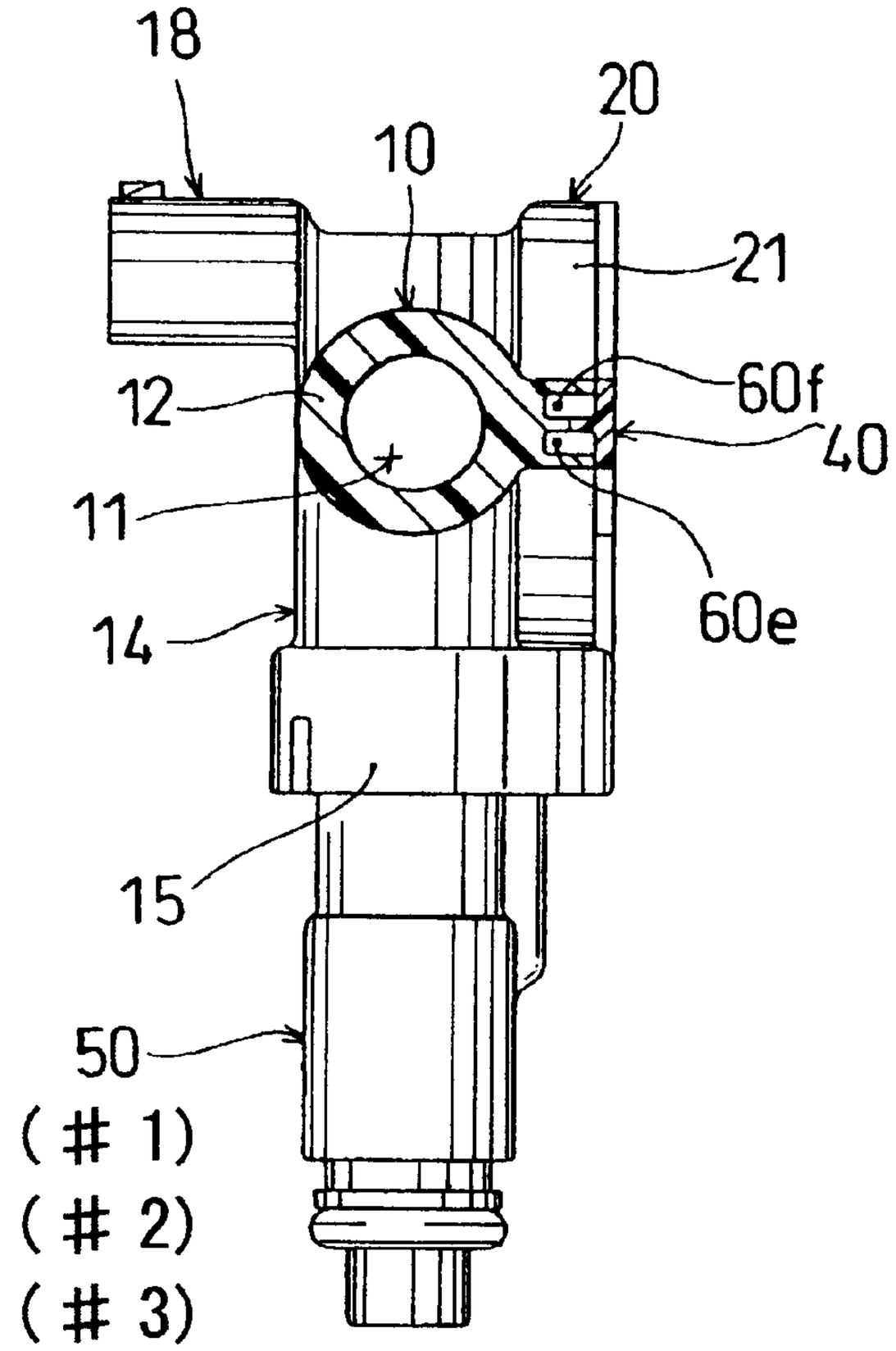
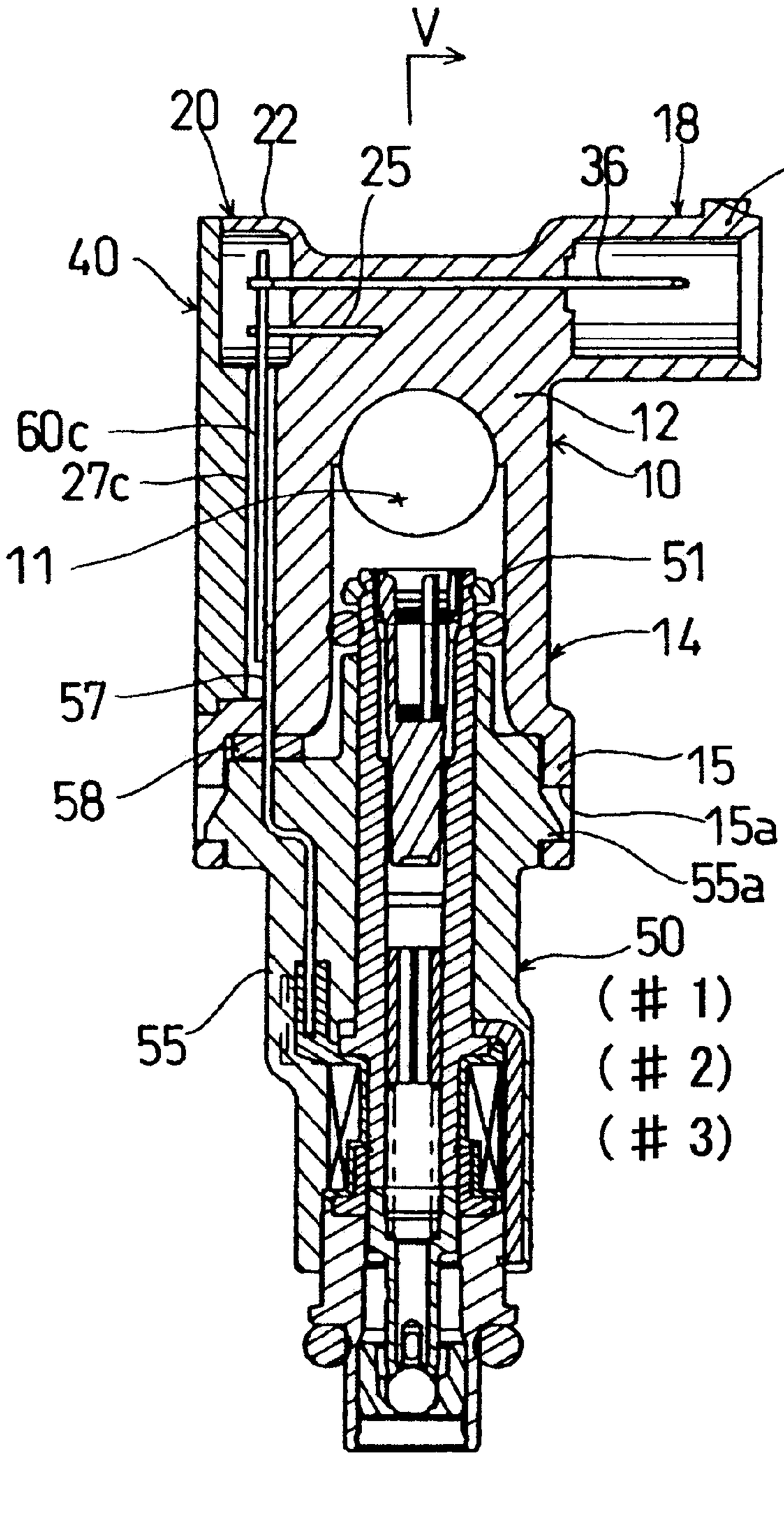


FIG. 3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20
22
25
36
18
18a
40
60c
27c
11
12
10
51
14
57
58
15
15a
55a
50
55
(# 1)
(# 2)
(# 3)
V

FIG. 4

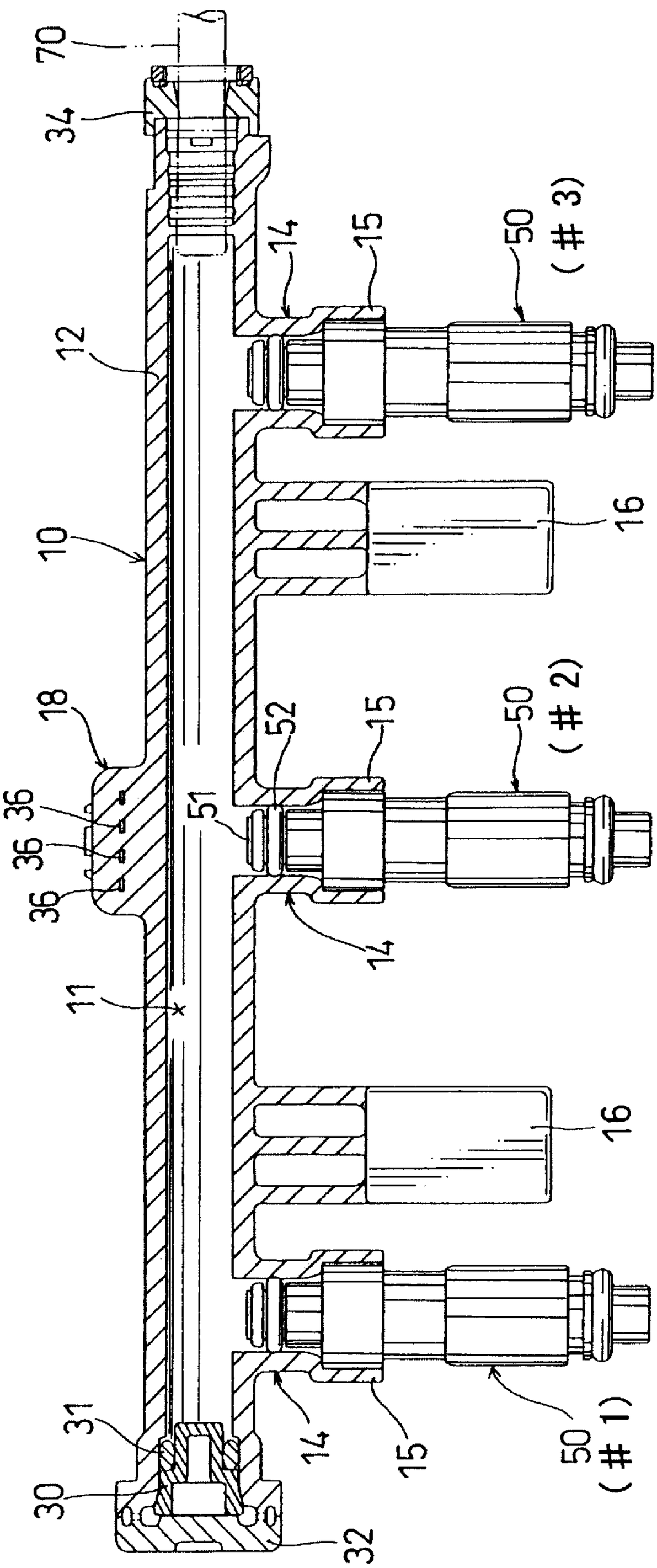

70
34
12
10
18
36
36
36
11
31
30
32
14
15
50
(#3)
16
52
15
50
(#2)
51
14
16
14
15
50
(#1)

FIG. 5

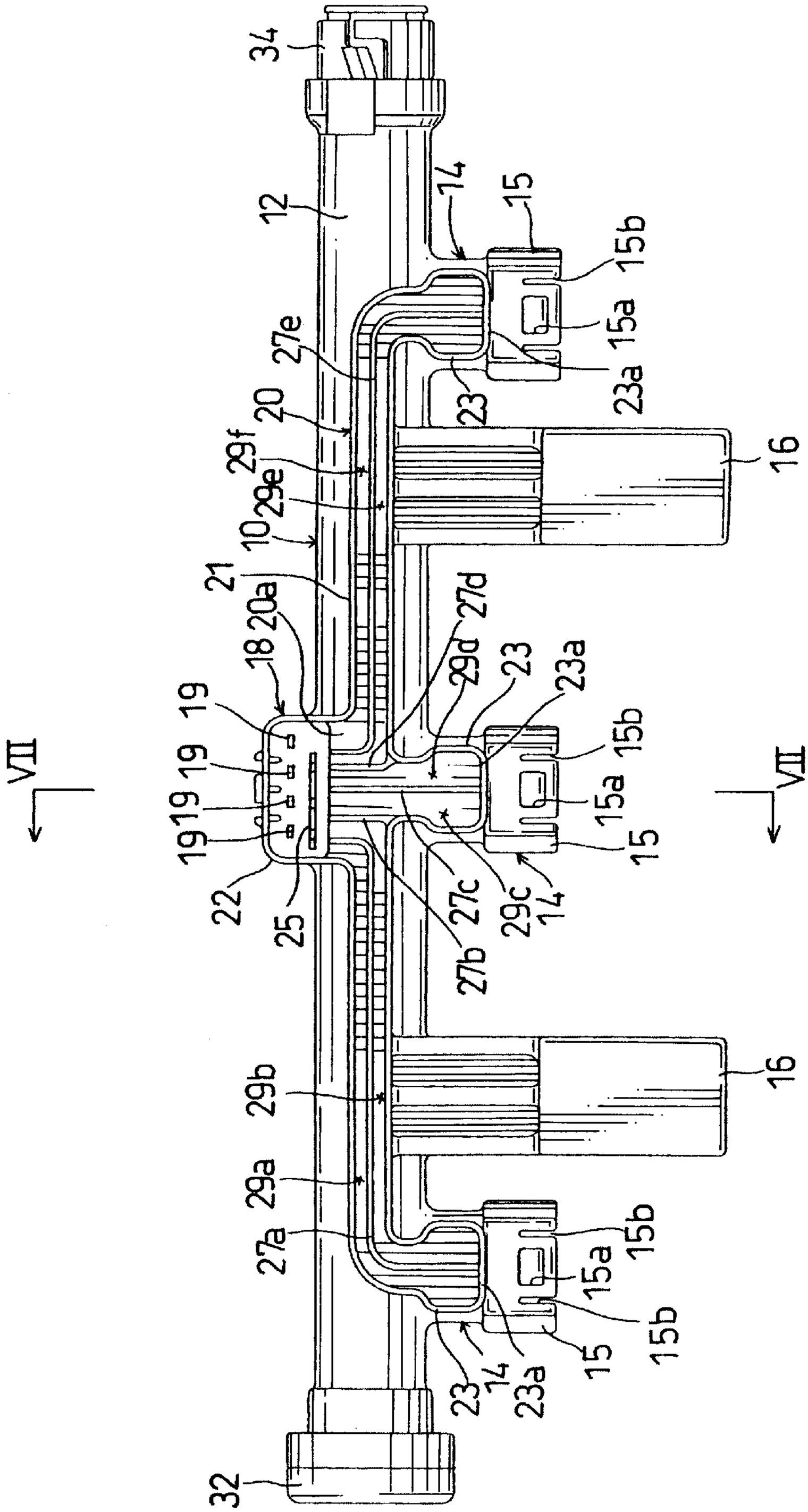

34
12
14
15
15b
15a
23a
23
27e
20
29f
29e
10
21
18
20a
27d
29d
19
22
25
27c
29c
27b
14
29b
29a
27a
32
16
VII
VII

FIG. 6

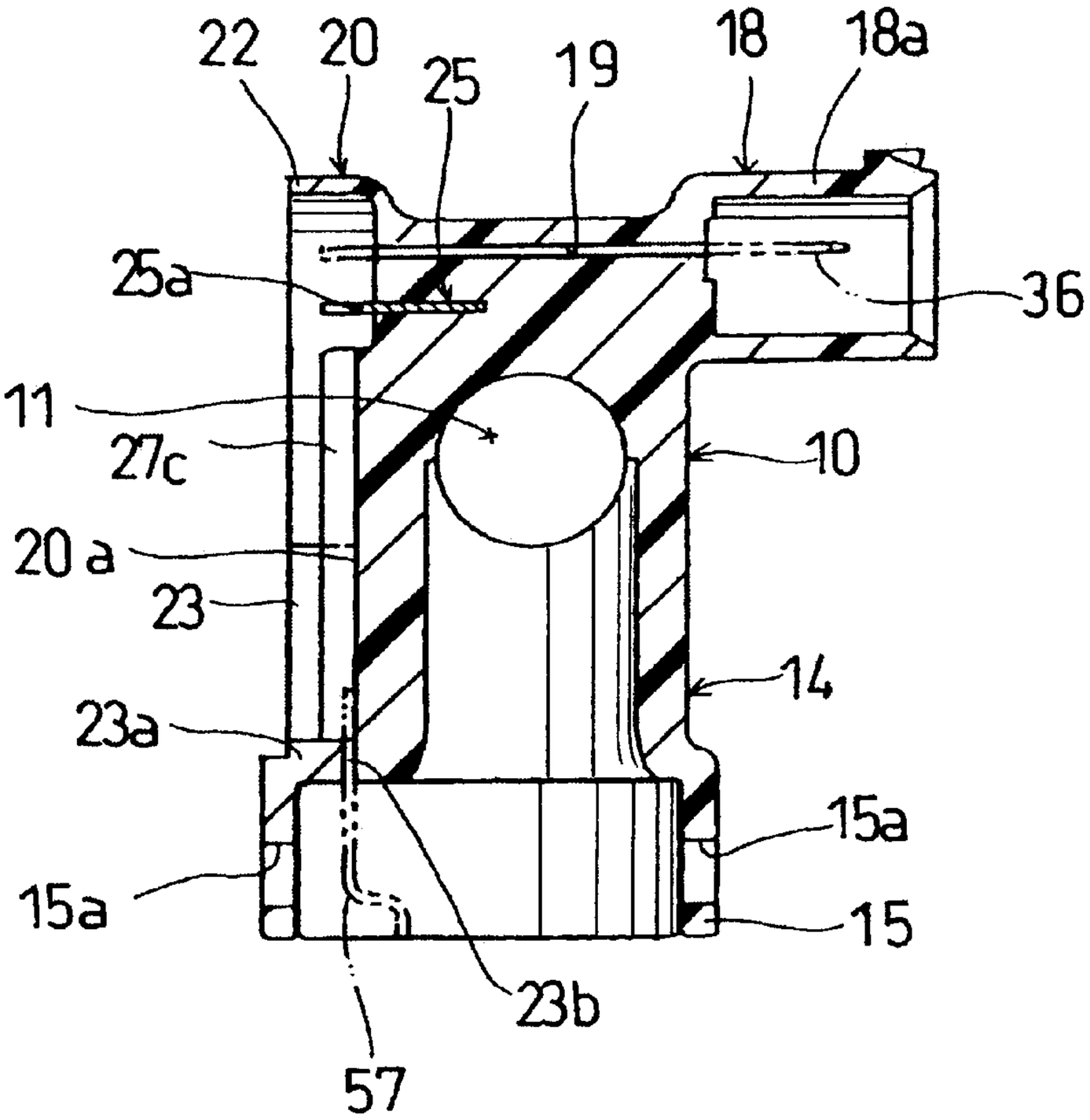


FIG. 7

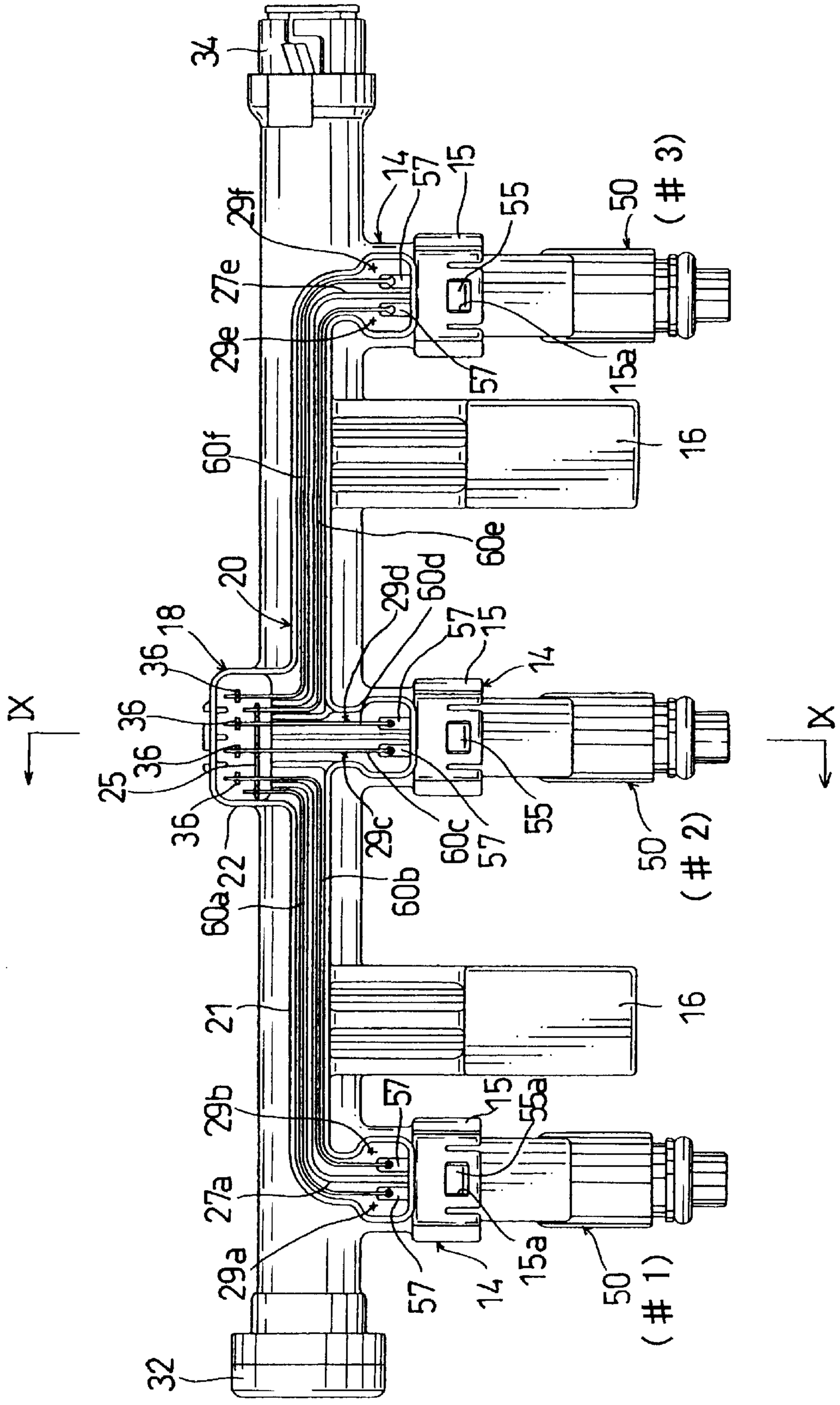

34
29f
14
57
15
55
50
(#3)
27e
29e
57
15a
16
60f
60e
20
29d
60d
57
15
18
36
36
36
25
36
36
14
IX
IX
29c
60c
57
55
50
(#2)
22
60a
60b
21
16
57
15
55a
29b
27a
29a
57
14
15a
50
(#1)
32

FIG. 8

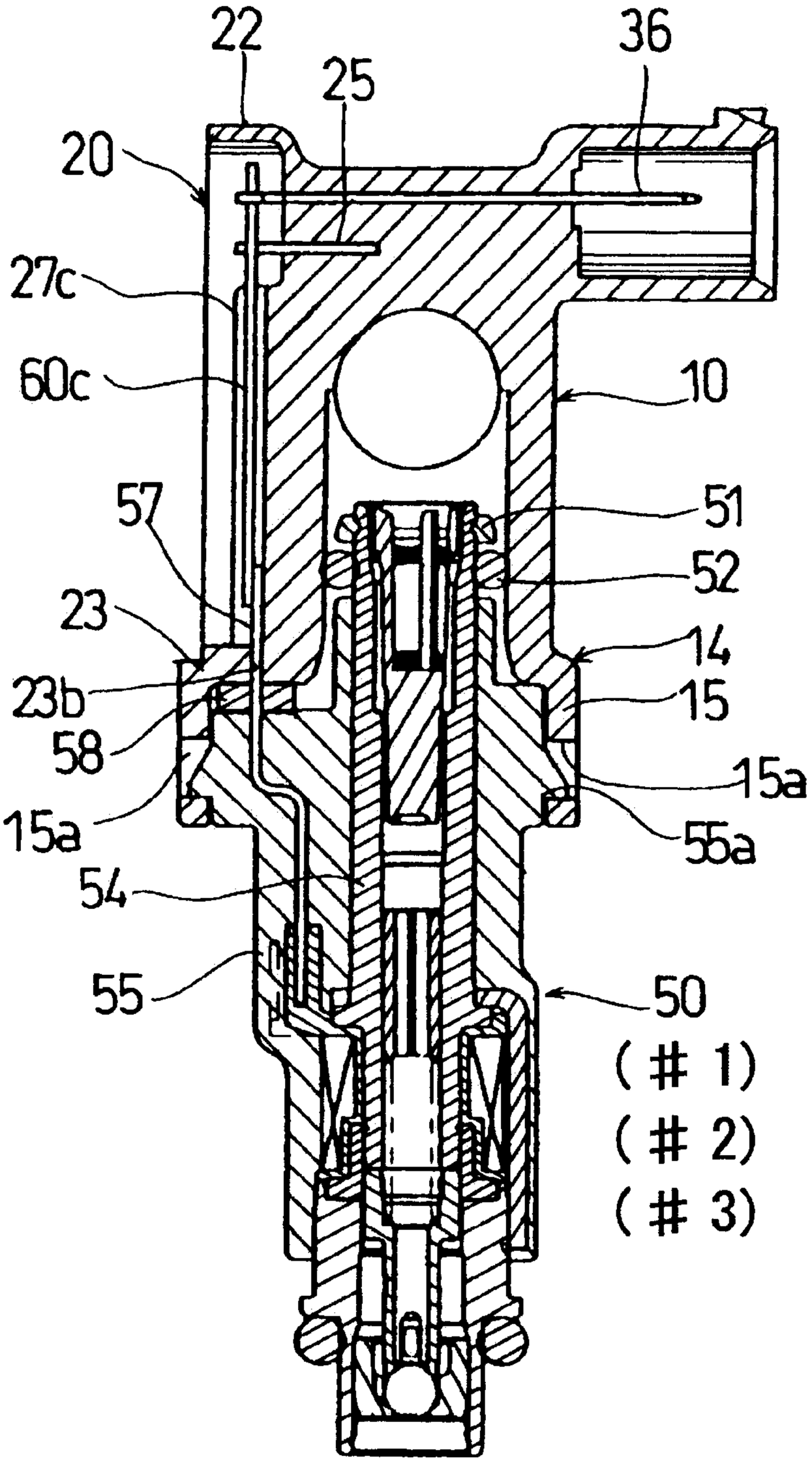

22
25
36
20
27c
60c
10
57
51
52
23
14
23b
15
58
15a
15a
56a
54
55
50
(# 1)
(# 2)
(# 3)

FIG. 9

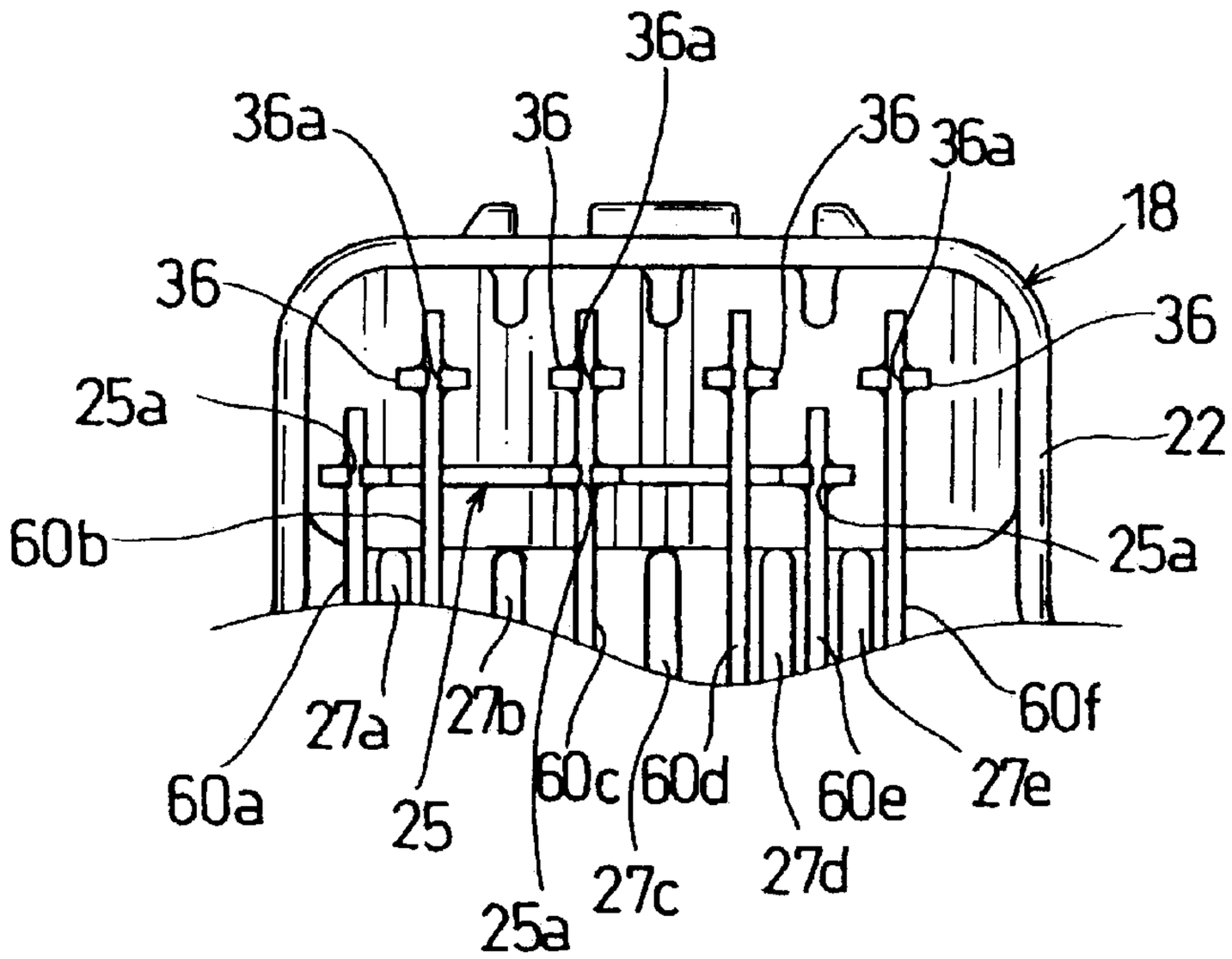

36a
36a
36
36
36a
18
36
36
25a
22
25a
60b
60f
27a
27b
60a
25
60c
60d
60e
27e
25a
27c
27d

FIG. 10

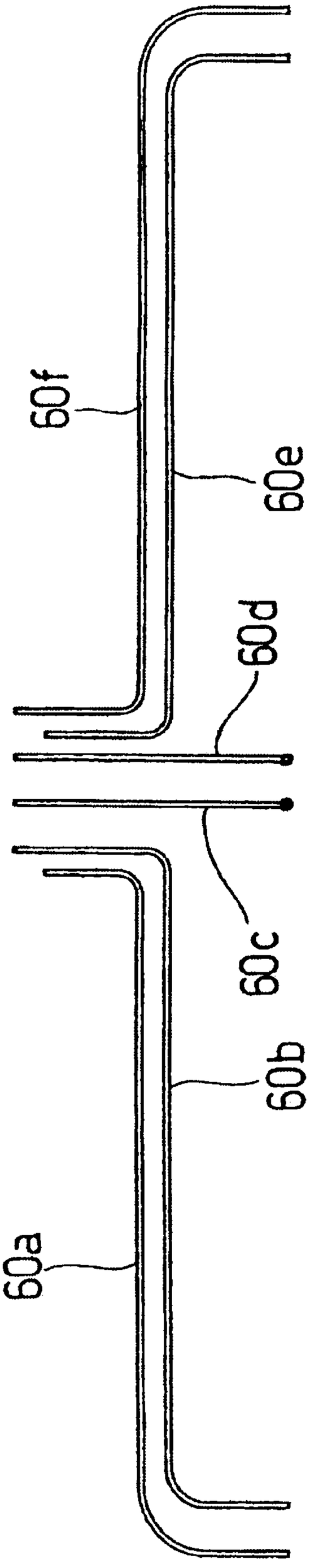


FIG. 11

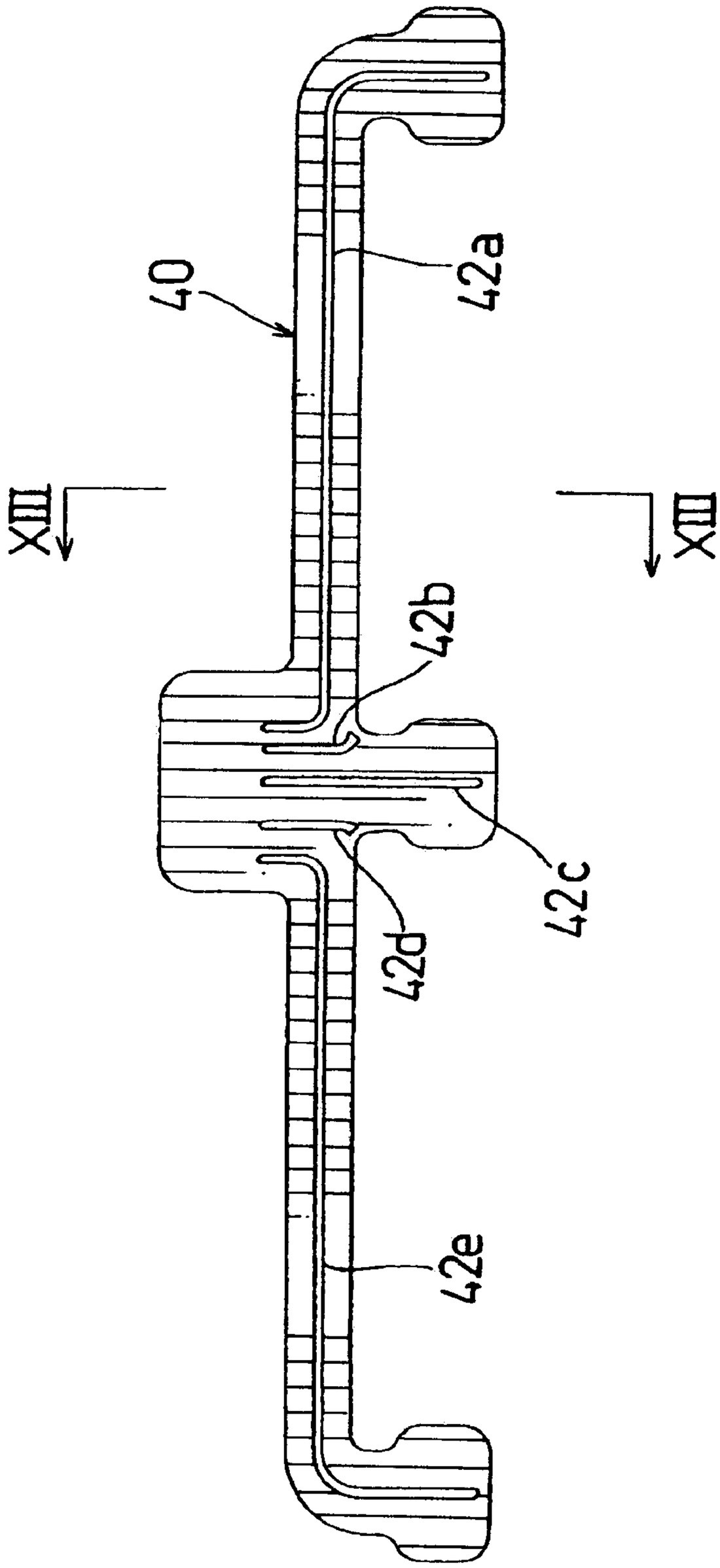


FIG. 12

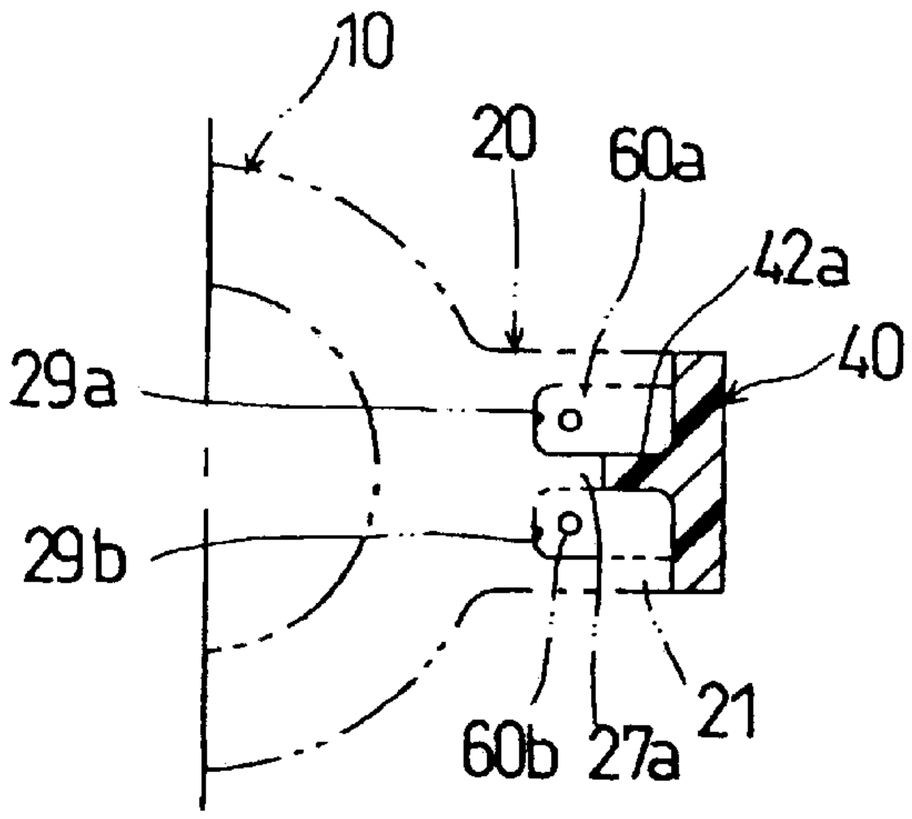


FIG. 13

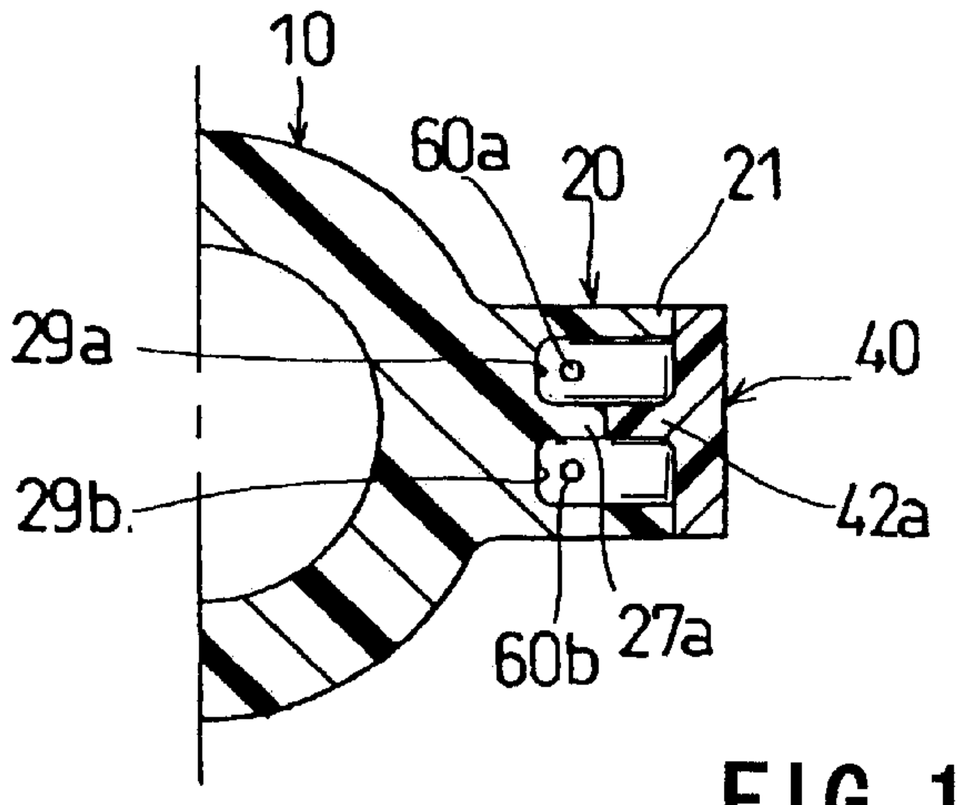


FIG. 14

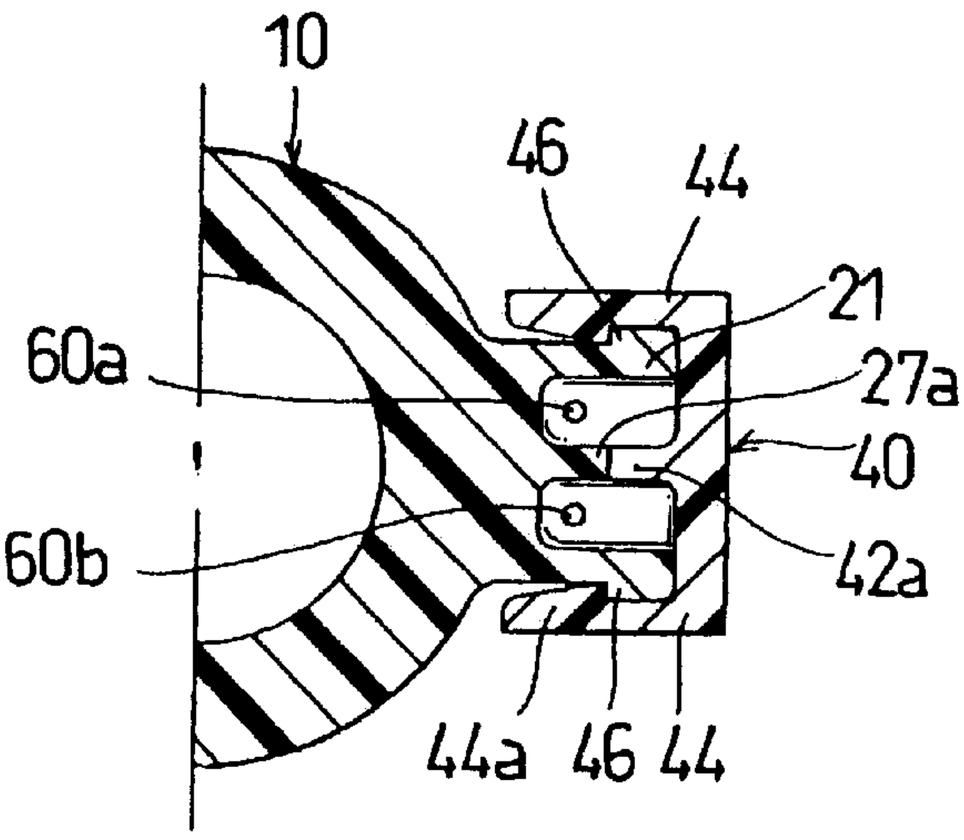


FIG. 15

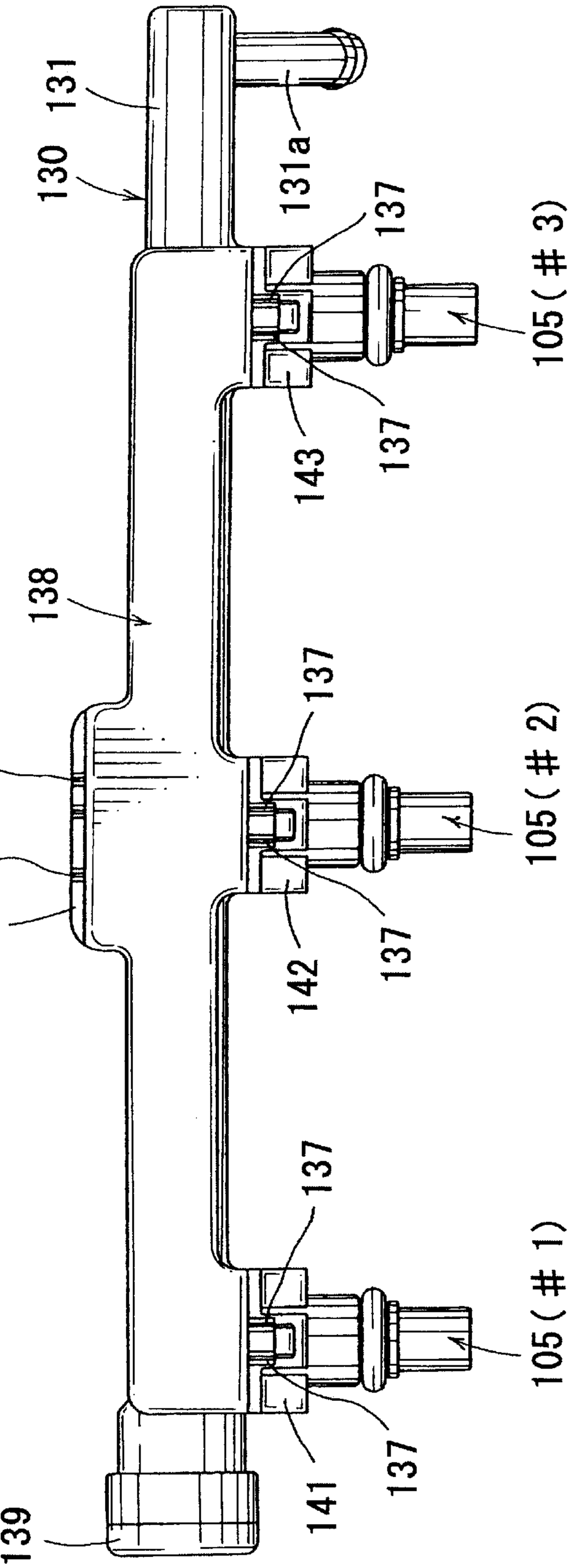

130
131
131a
137
105(#3)
143
137
138
137
135a
137
105(#2)
142
137
137
105(#1)
139
141
137

FIG. 16

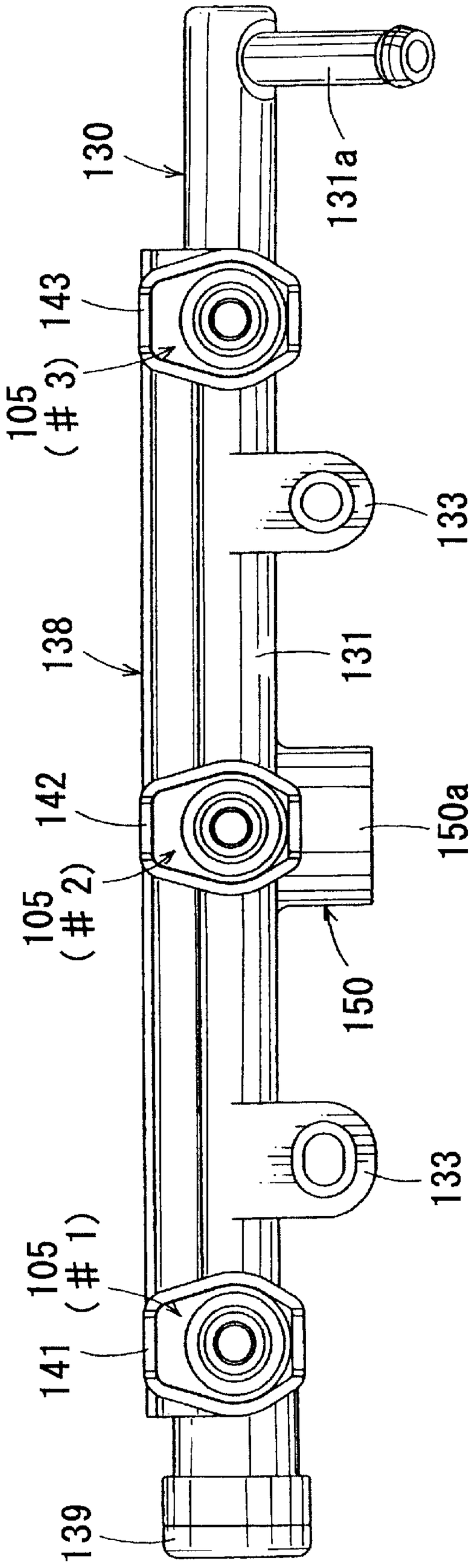

130
131a
143
105
(# 3)
133
138
131
142
105
(# 2)
150a
150
133
141
105
(# 1)
139

FIG. 17

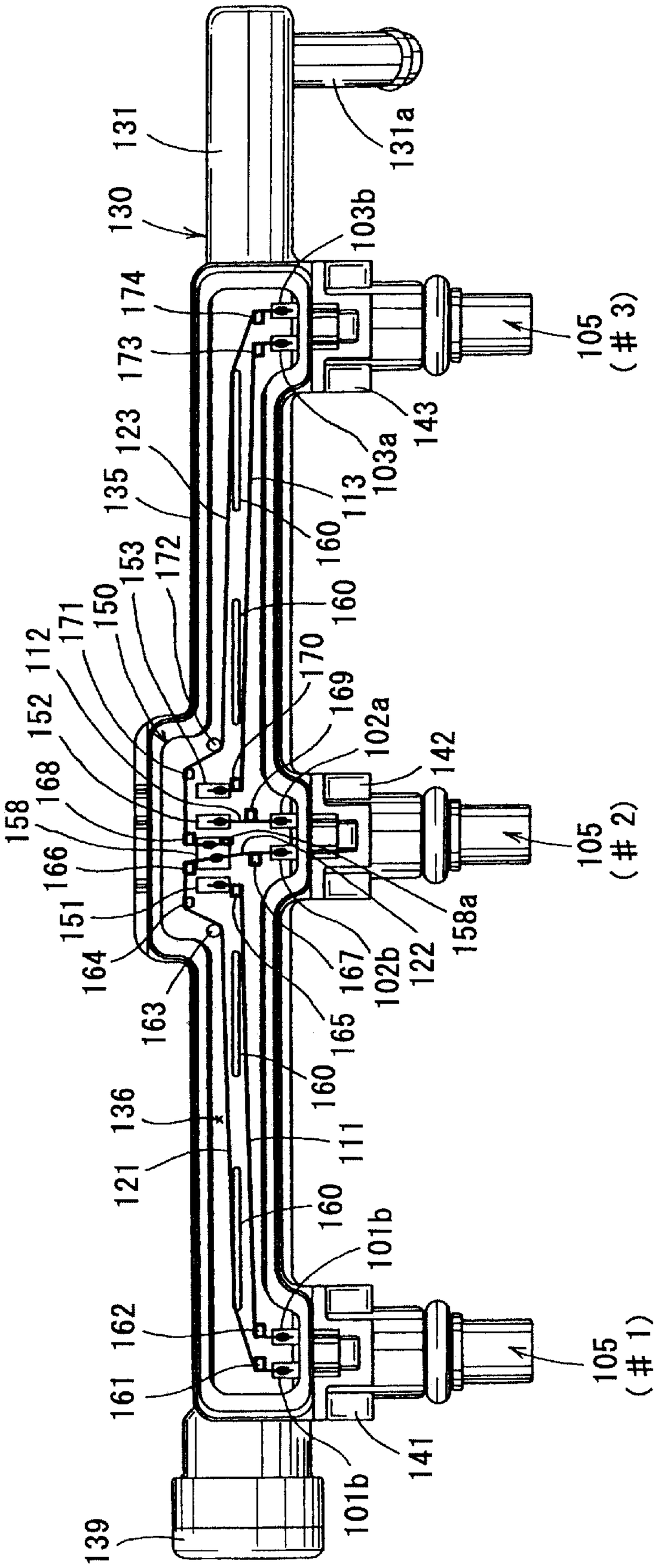
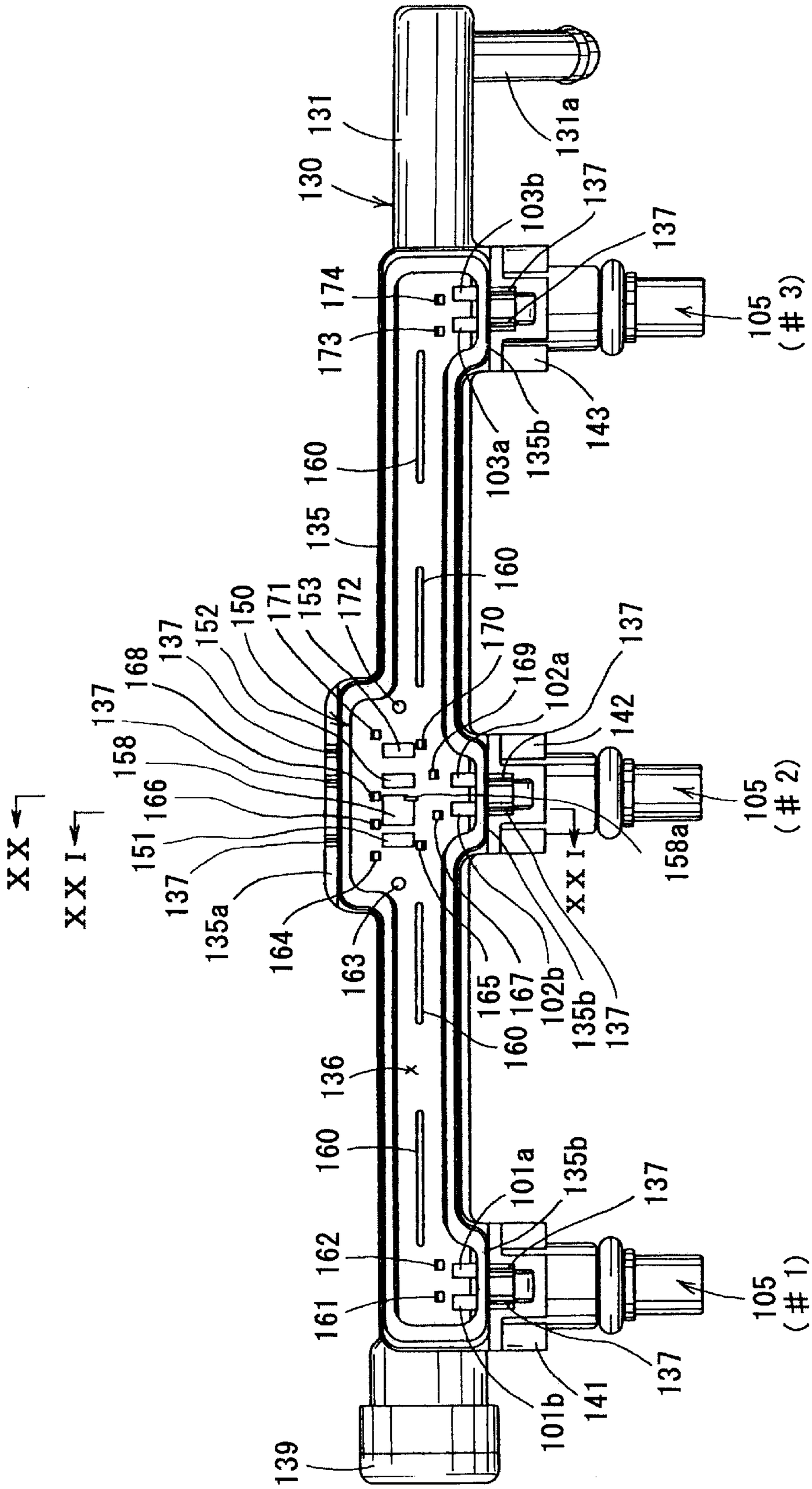

131
131a
130
103b
174
173
105
(#3)
123
143
135
103a
113
160
153
172
150
160
171
112
170
152
169
102a
168
142
158
102
166
105
(#2)
151
158a
164
167
102b
122
163
165
160
136
111
121
160
101b
162
161
141
139
101b
105
(#1)

FIG. 18


130
131
131a
103b
137
137
174
173
105
(#3)
143
135b
103a
160
135
160
170
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102a
142
137
172
153
171
150
152
137
168
137
158
166
151
137
135a
164
163
165
167
102b
135b
137
160
136
160
101a
135b
137
162
161
141
137
105
(#1)
139
101b
158a
XX
XXI
XXI
XX

FIG. 19

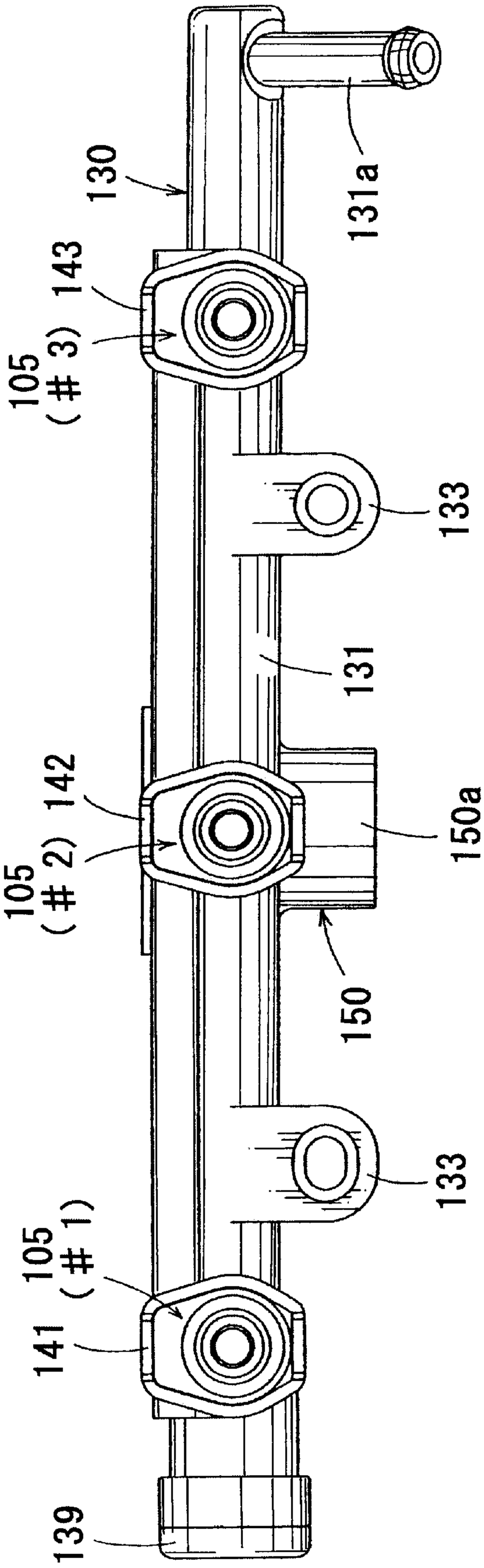


FIG. 20

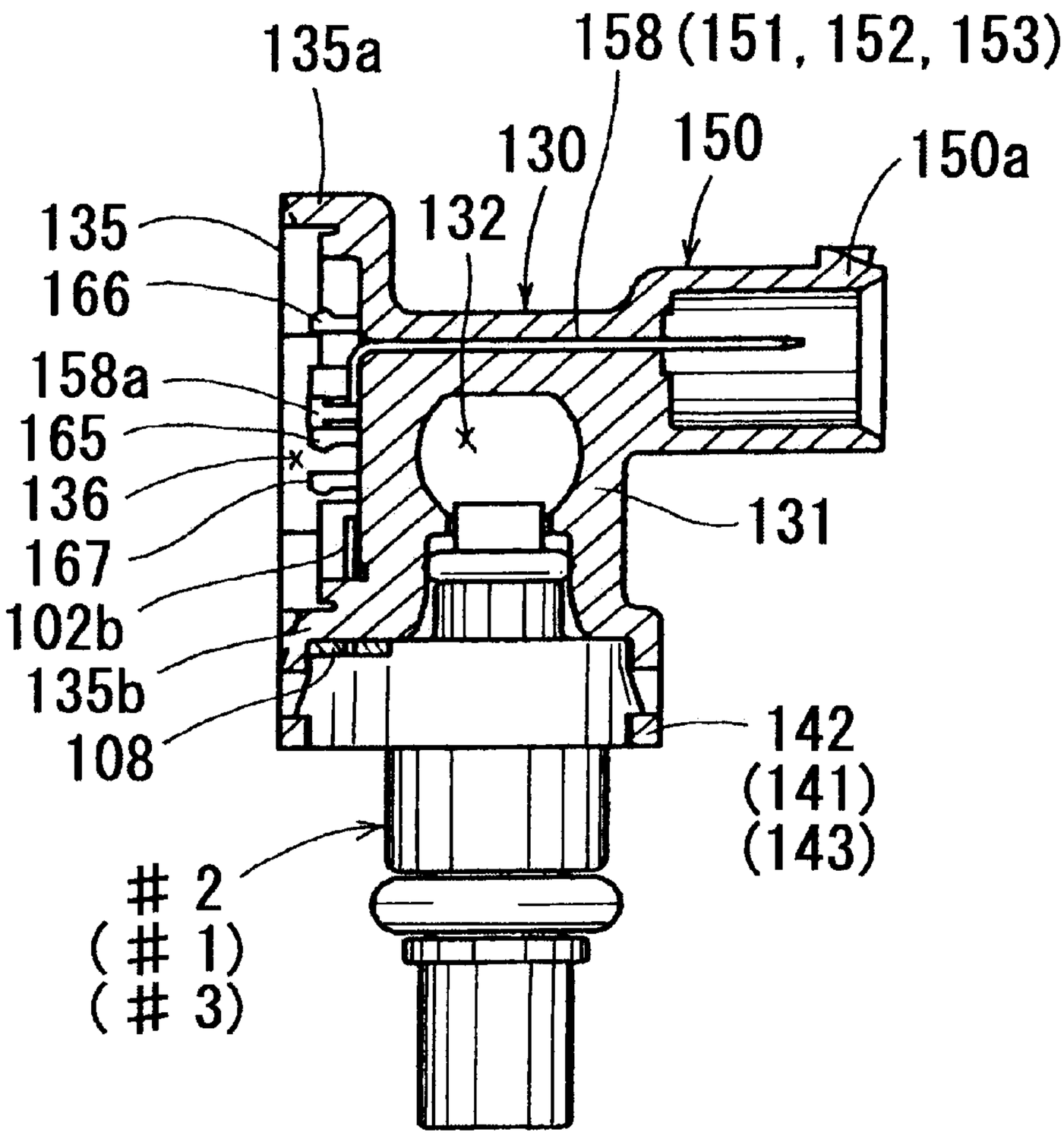
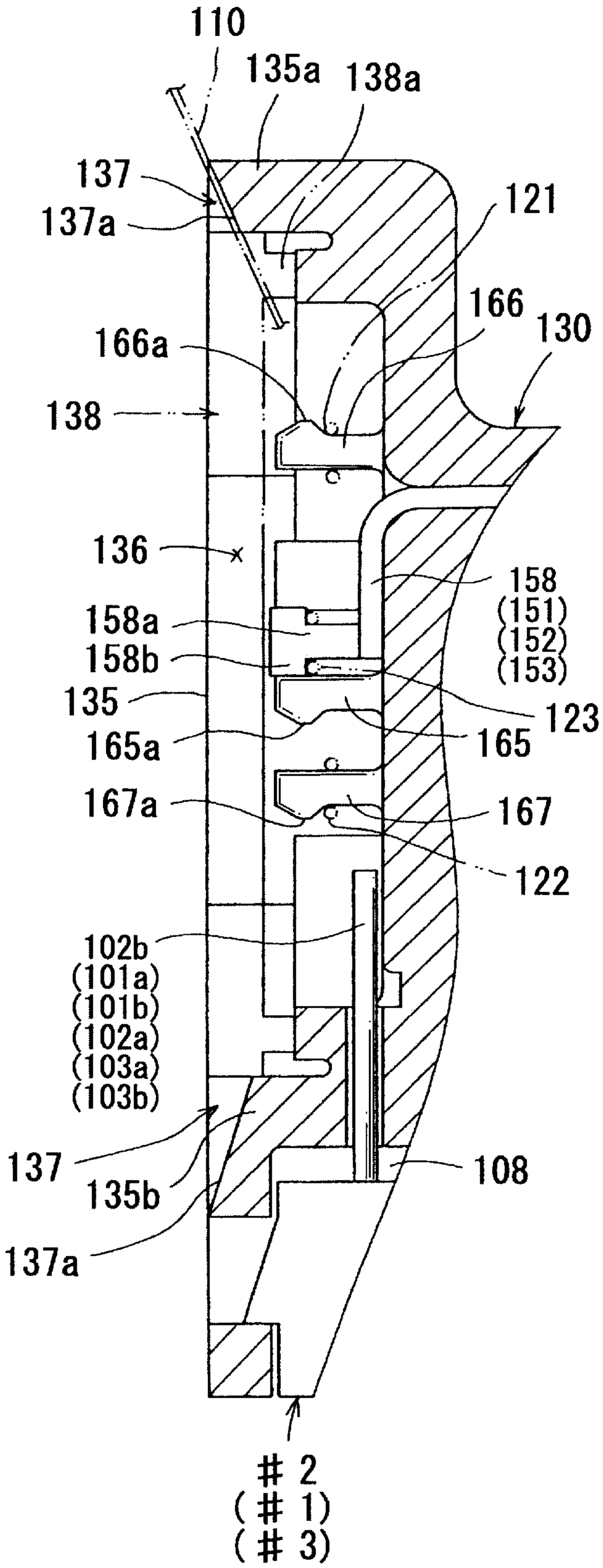

135a
158 (151, 152, 153)
130
150
150a
135
132
166
158a
165
136
167
102b
135b
108
131
142
(141)
(143)
2
(# 1)
(# 3)

FIG. 21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135a
138a
137
137a
121
166
166a
130
138
136
158
(151)
(152)
(153)
158a
158b
135
123
165a
165
167a
167
122
102b
(101a)
(101b)
(102a)
(103a)
(103b)
137
135b
108
137a
2
(# 1)
(# 3)

FIG. 22

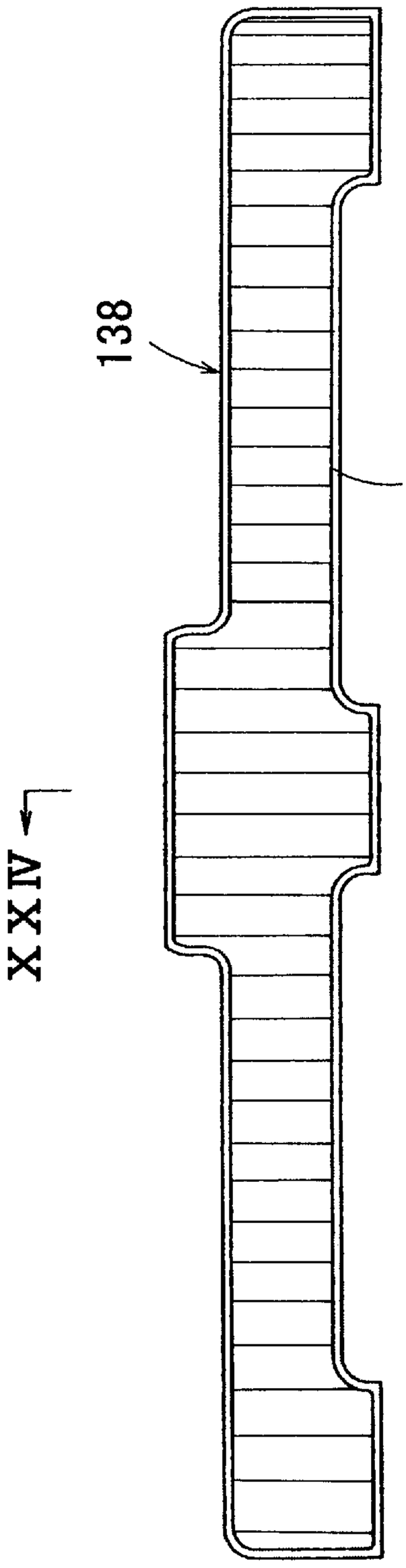


FIG. 23

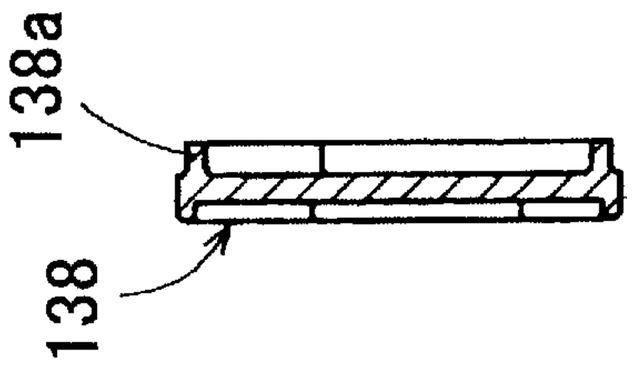


FIG. 24

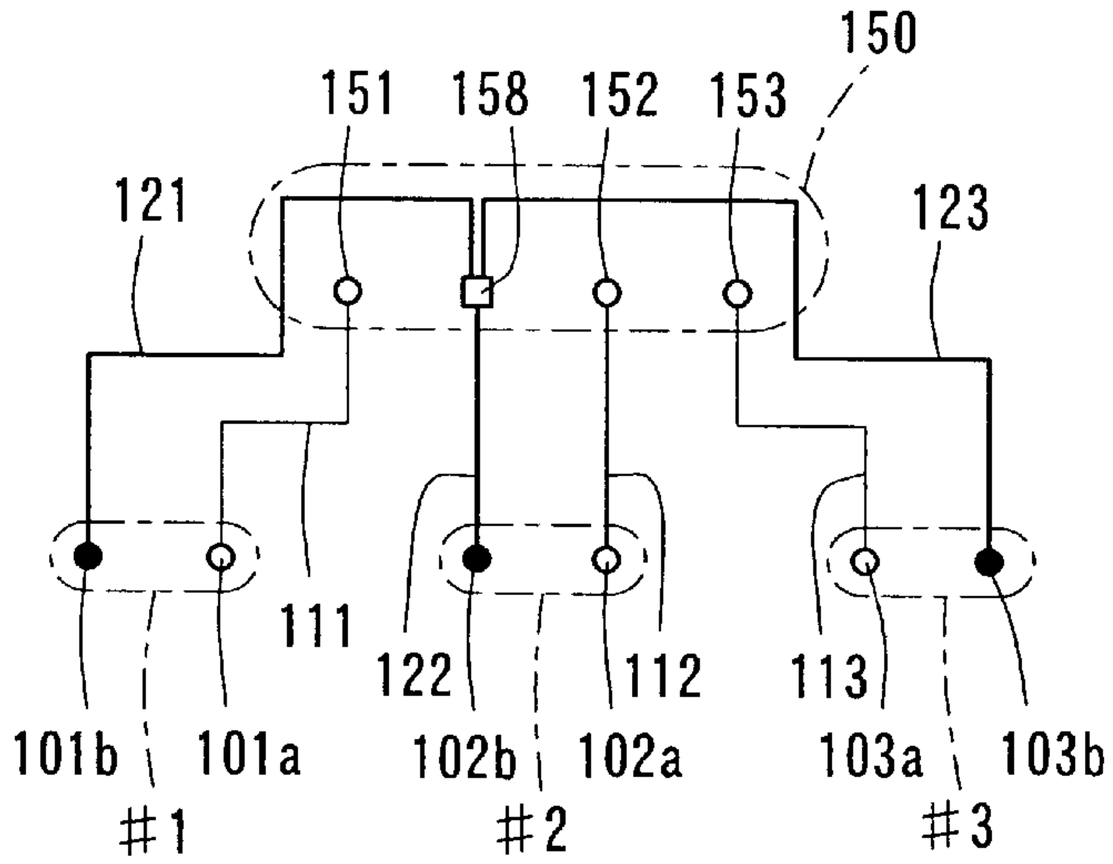

150
151
158
152
153
121
123
111
122
112
113
101b
101a
102b
102a
103a
103b
#1
#2
#3

FIG. 25

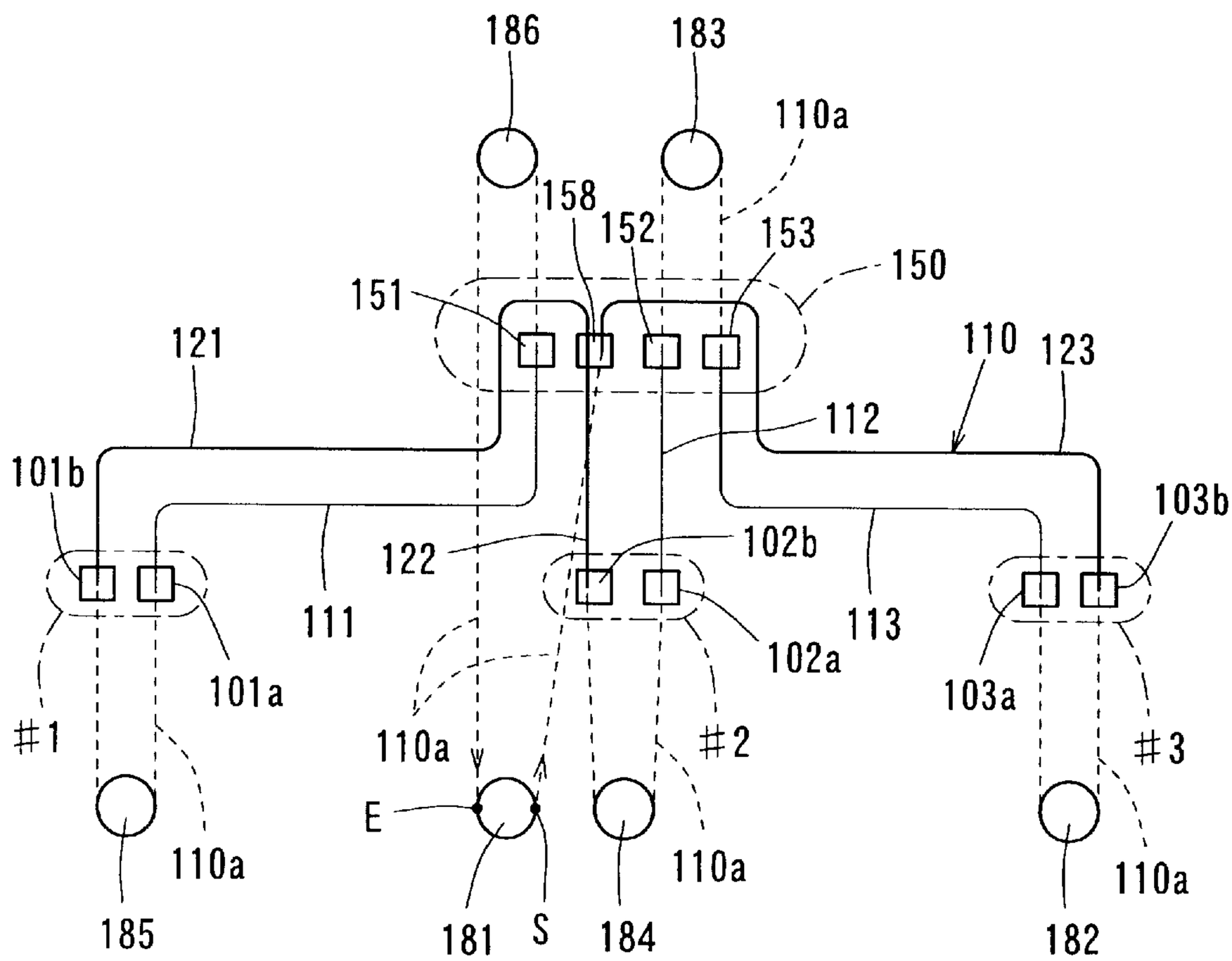
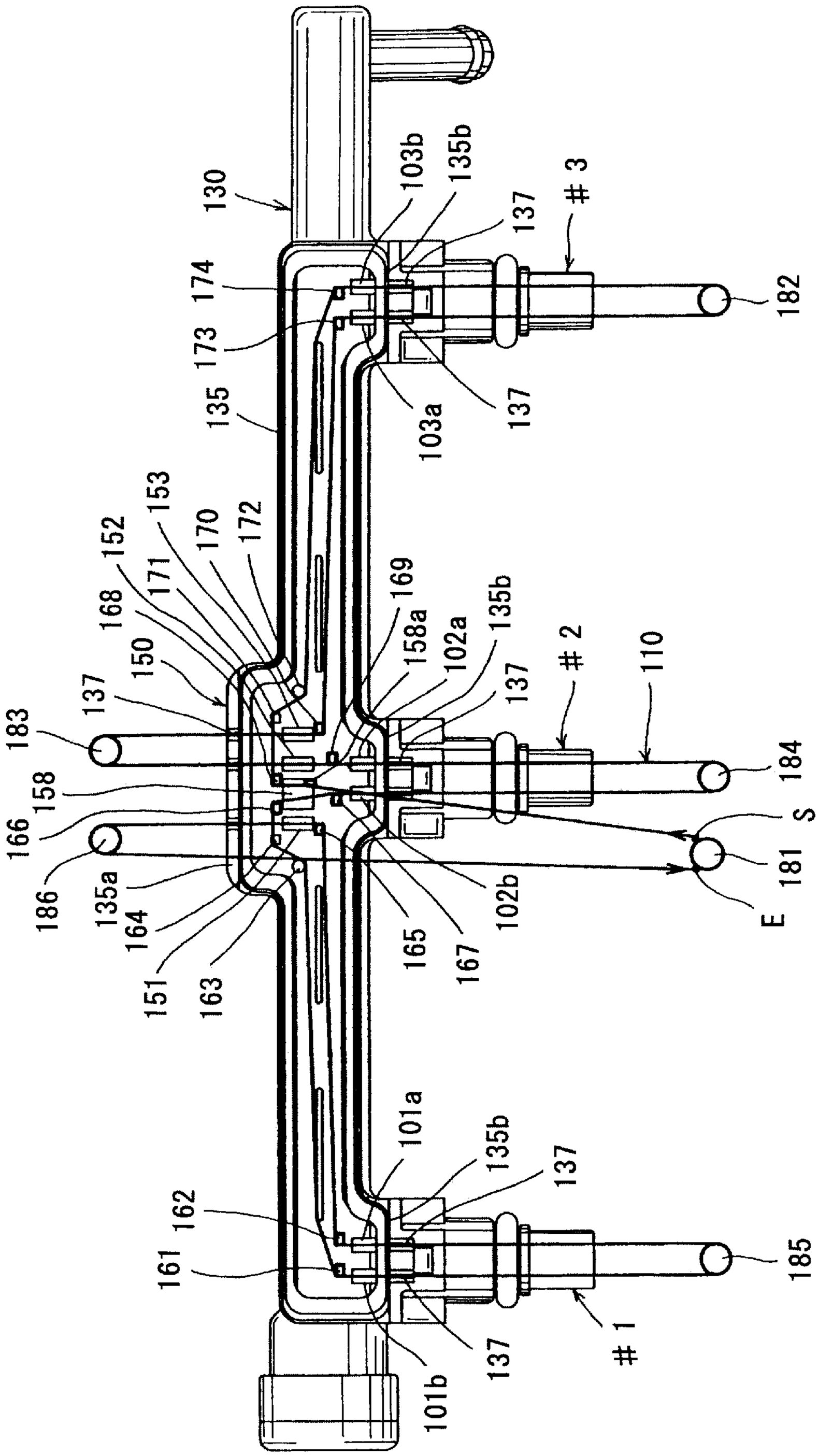

186
183
110a
158
152
153
150
151
121
110
123
112
101b
103b
122
102b
111
113
102a
101a
103a
#1
#2
#3
110a
E
110a
110a
185
181
S
184
182

FIG. 26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158a
102a
135b
137
2
110
183
158
166
184
S
186
135a
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163
101a
135b
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161
185
137
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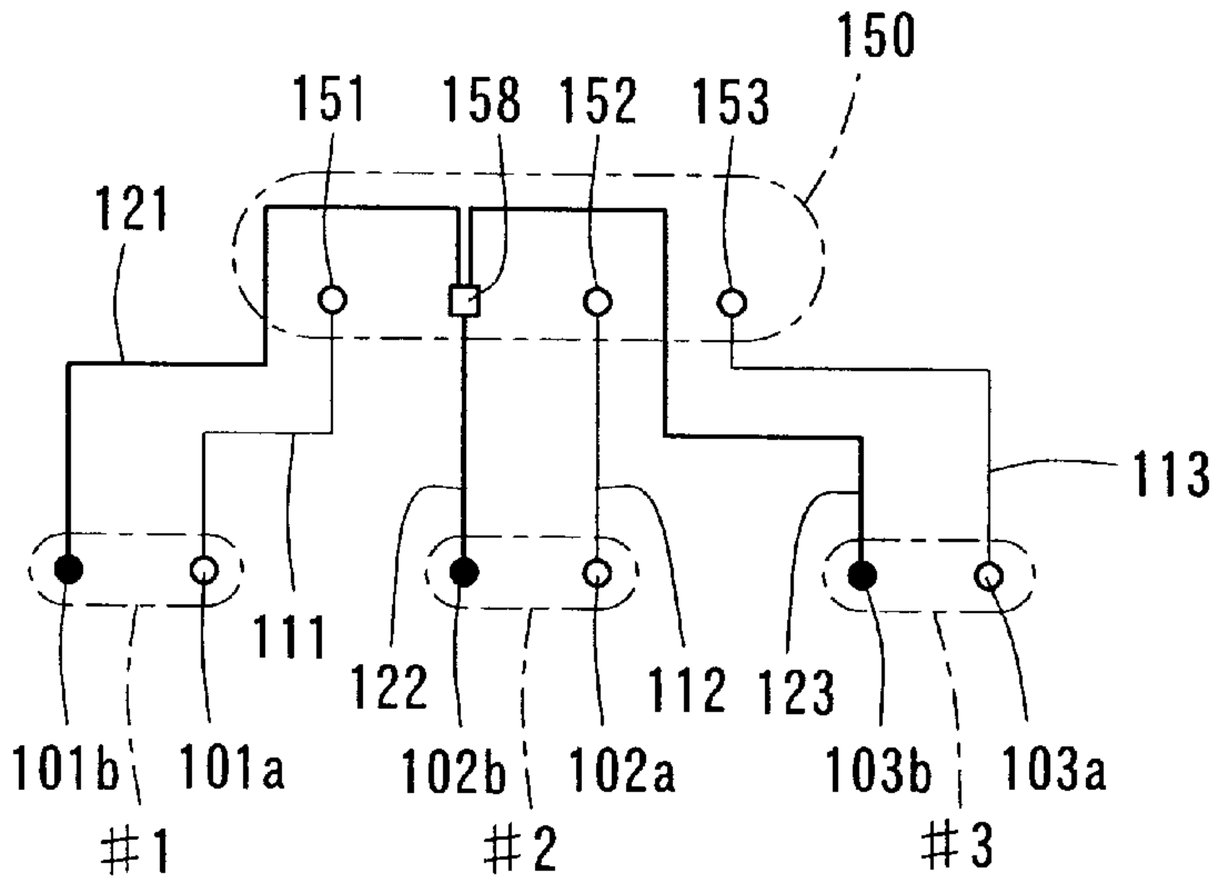
101b

FIG. 27


150
151
158
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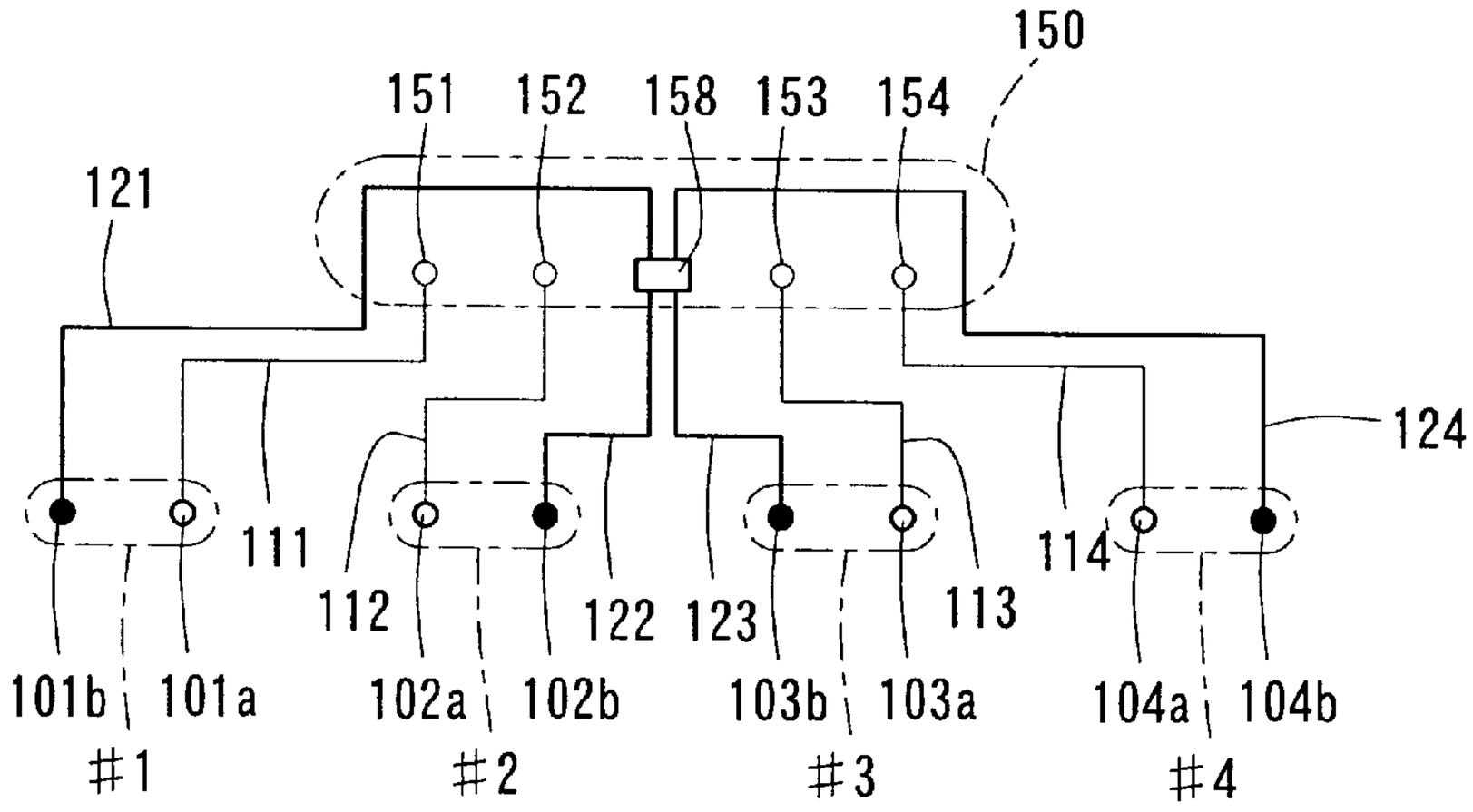
153
121
113
111
122
112
123
101b
101a
102b
102a
103b
103a
#1
#2
#3

FIG. 28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151
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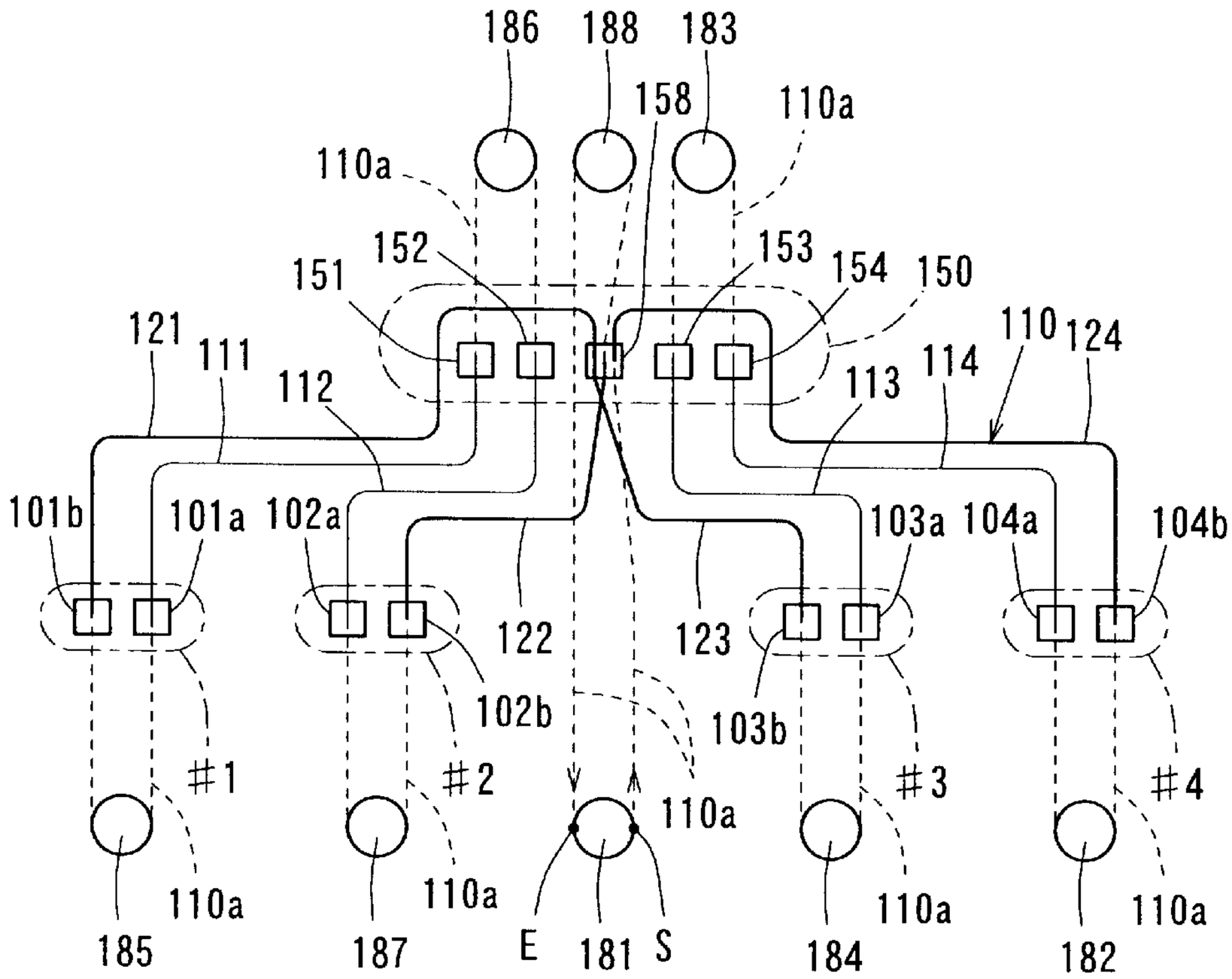
158
153
154
121
124
111
112
122
123
113
114
101b
101a
102a
102b
103b
103a
104a
104b
#1
#2
#3
#4

FIG. 29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102a
103a
104a
104b
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#1
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E
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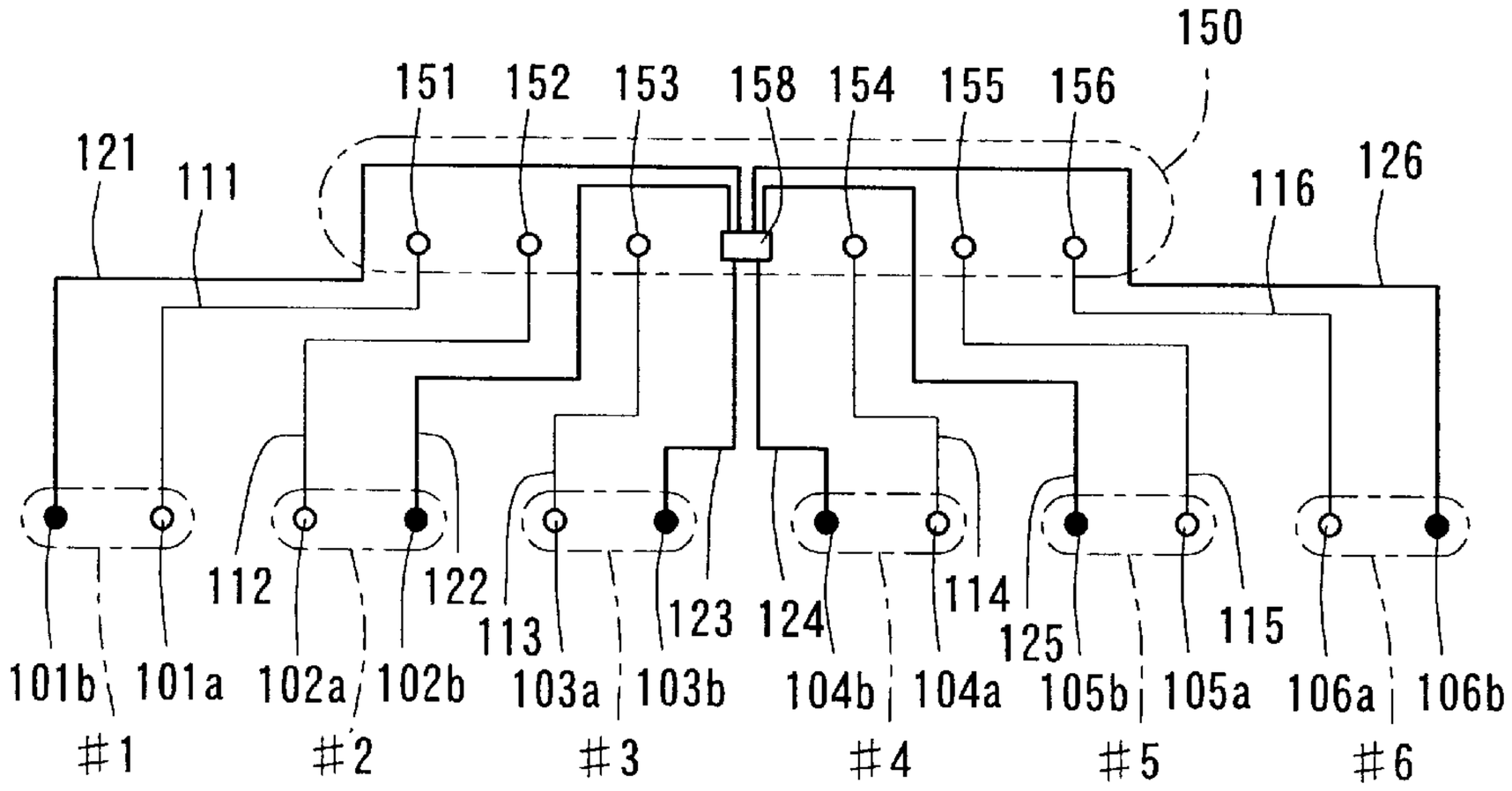
S
184
182

FIG. 30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102a
102b
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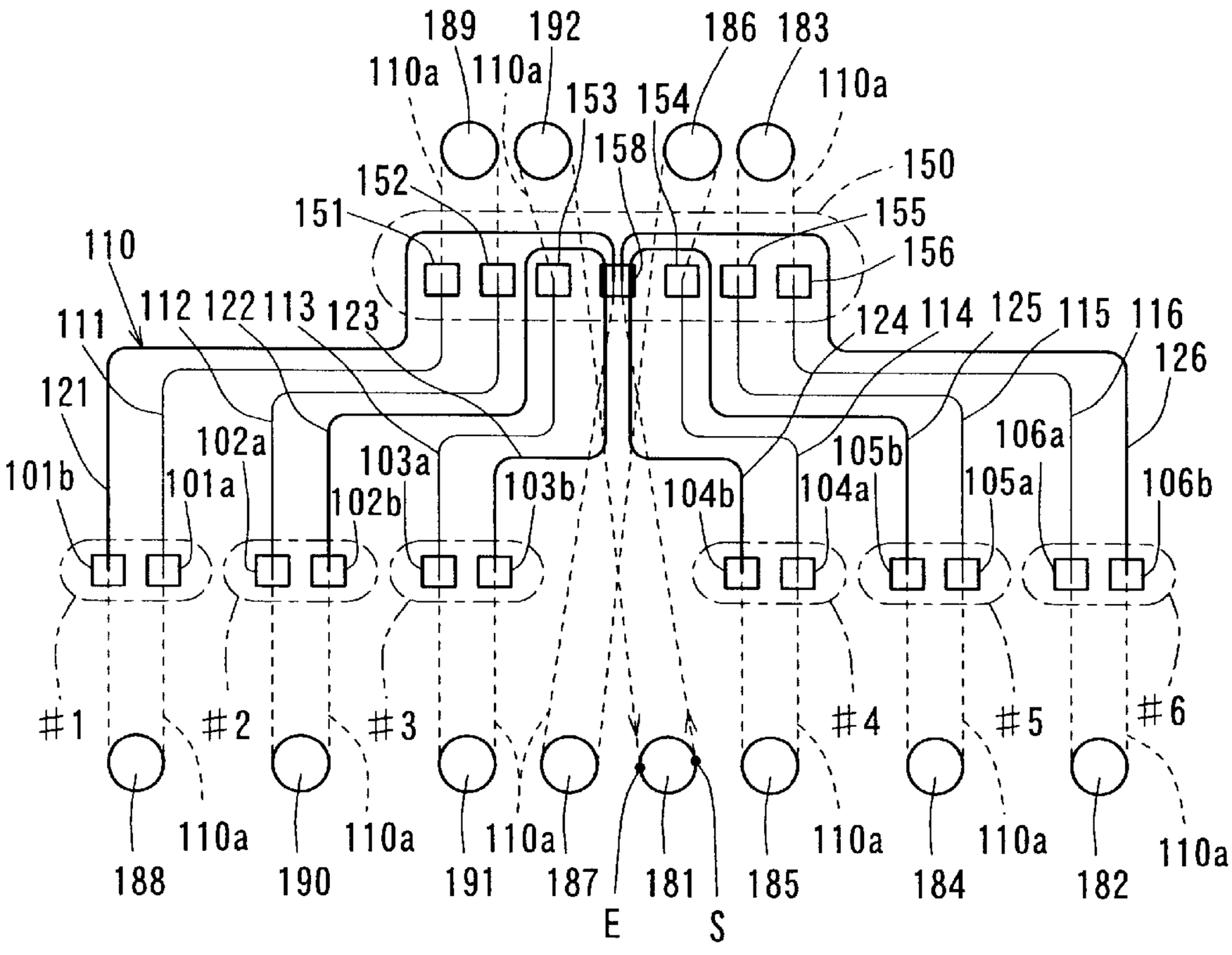
#2
#3
#4
#5
#6

FIG. 31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103a
105b
106a
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102b
103b
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105a
106b
#1
#2
#3
#4
#5
#6
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110a
188
190
191
187
181
185
184
182
E
S

FIG. 32

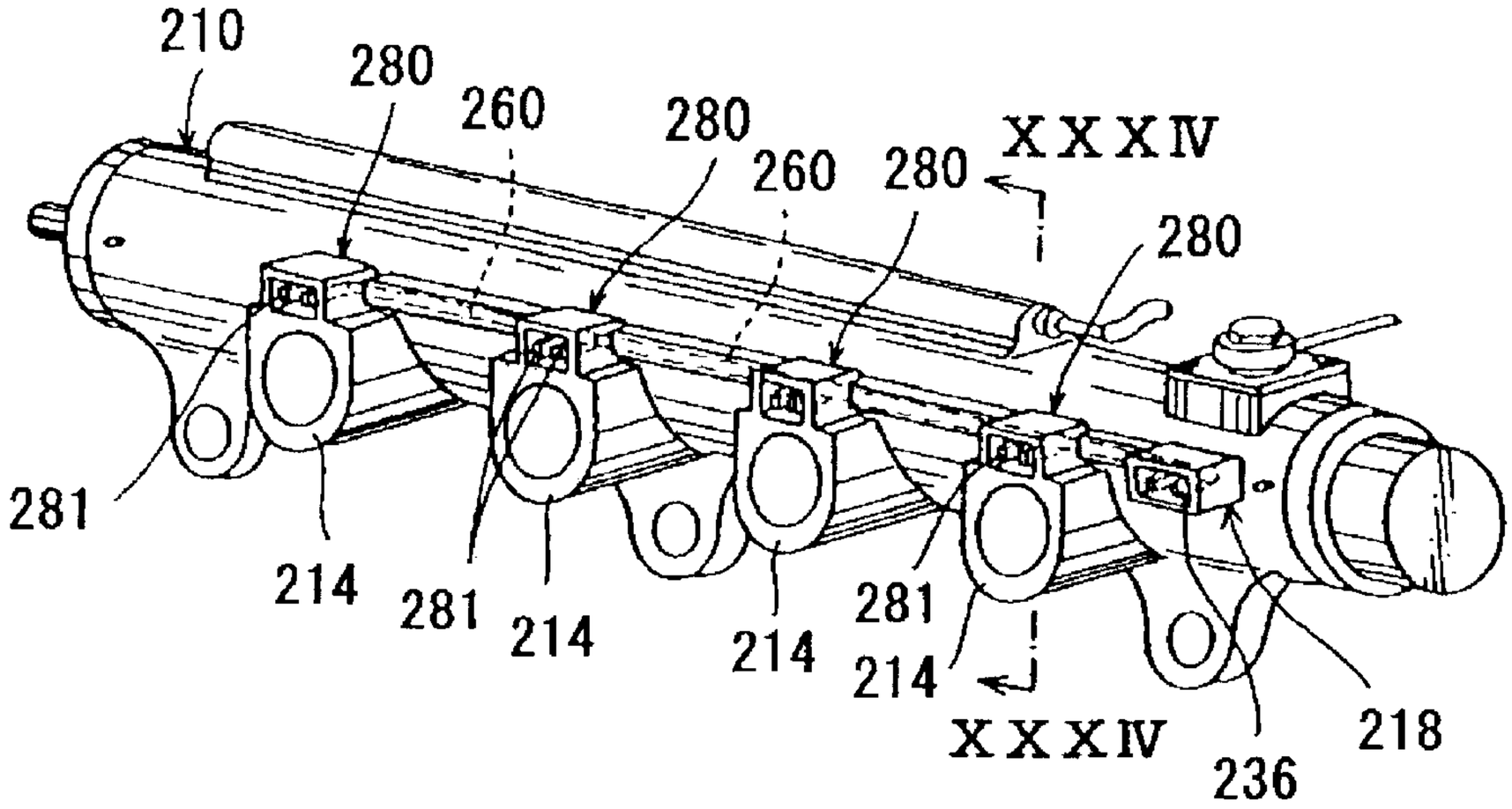

FIG. 33
PRIOR ART

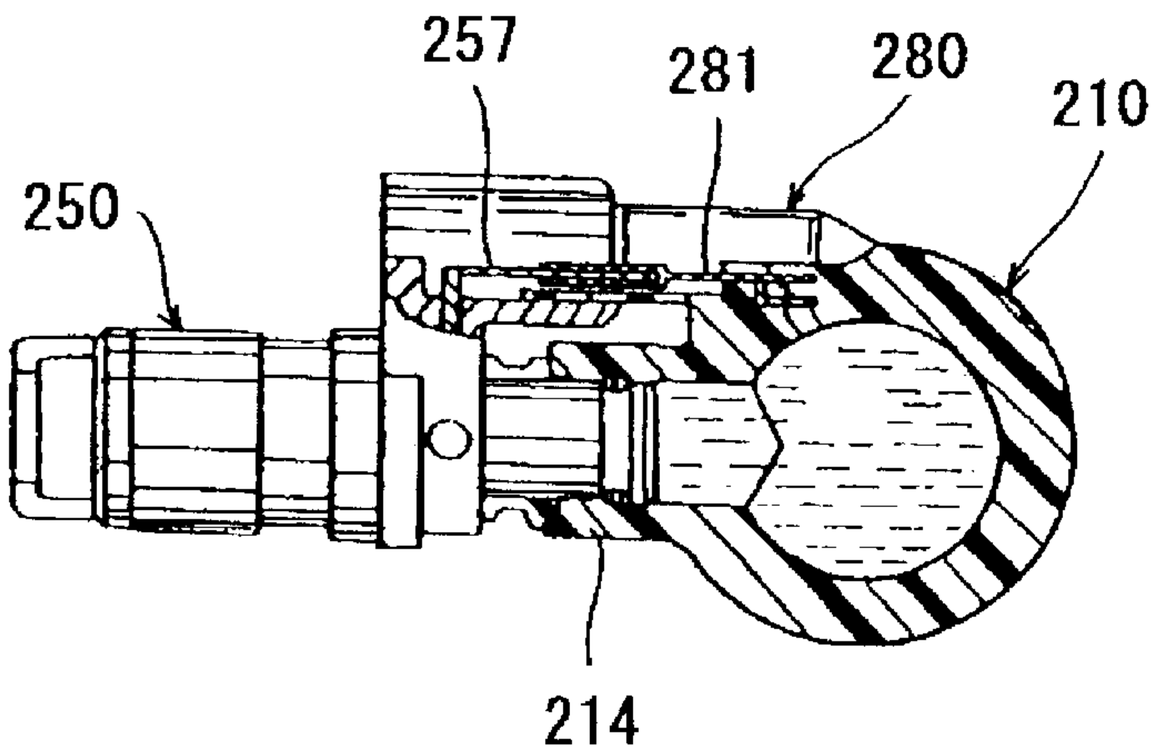

FIG. 34
PRIOR ART

FUEL DELIVERY PIPES

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to fuel injection systems for internal combustion engines and, more particularly, to fuel delivery pipes for delivering fuel to fuel injectors.

2. Description of the Related Art

An example of a known fuel delivery pipe is shown in FIGS. **33** and **34**. As shown in FIG. **33**, the fuel delivery pipe has a cylindrical main body **210** and a plurality of injector connecting portions **214** mounted on the main body **210**. Further, as shown in FIG. **34**, an injector **250** is connected to each of the injector connecting portions **214**. Fuel is supplied into the main body **210** of the fuel delivery pipe and then to each injector **250**.

The main body **210** is integrally formed of a synthetic resin or a composite of a synthetic resin and other materials. An external wiring connector **218** is integrally formed with the main body **210** and has a connecting terminal **236** to which a fuel injection signal is supplied by external wiring. An injector connector **280** is provided on each injector connecting portion **214** and has a connecting terminal **281**. The connecting terminal **281** is connected to a connecting terminal **257** of each injector **250**. The connecting terminal **236** of the connector **218** is connected to the connecting terminal **281** of the injector connector **280** by wires **260**. The wires **260** are embedded or installed within the main body **210** by injection molding when the main body **210** is molded. Such a fuel delivery pipe in which wires **260** are installed within the main body by injection molding is disclosed, for example, in Japanese Patent Publication No. 3-39194 and Japanese Laid-Open Patent Publication No. 8-303319.

In this known fuel delivery pipe, the wires **260** have a tendency to become distorted as a result of the high molding pressure applied to the wires when the main body **210** is molded. The distortion of the wires **260** may result in wiring defects, such as breakage or short circuits or exposure of the wires **260** on the outer surface of the main body **210**.

Japanese Laid-Open Patent Publication No. 10-184490 discloses a connector block for a fuel injector in which the wires are not installed by an injection molding process. The connector block has a plurality of injector connectors and an external wiring connector on the main body. Each of the injector connectors is adapted to be connected to a connecting terminal of the injector. Further, the connecting portion of each connector is adapted to be connected to the external wiring connector. The wires that connect the injector connector and the external wiring connector are embedded in a close relationship within a wire distribution enclosure.

However, in this known connector block, the wires cross or overlap each other within the wire distribution enclosure. Therefore, wiring defects may result, such as breakage or short circuits.

SUMMARY OF THE INVENTION

It is, accordingly, an object of the present teachings to provide improved fuel delivery pipes and wiring methods for the delivery pipes, which can reduce or substantially prevent wiring defects, such as breakage or short circuits.

In one aspect of the present teachings, fuel delivery pipes are taught that have a wire distribution enclosure for protecting wires that couple induction signals from an external

source to the injectors. Wall-like wiring guides are preferably provided within the wife distribution enclosure. The wires may be wound around or hooked on the wire guides. Preferably, the wire guides may be disposed in a position to change the wiring direction of the wires. The wall-like wiring guides may partition the wire distribution enclosure into sections and the wires may be separately laid in each of the sections. Thus, the wires do not cross each other, thereby reducing or preventing wiring defects, such as breakage or short circuits.

Further, a surrounding wall may be provided to surround the wire distribution enclosure, and connecting terminals of the injectors may extend through the surrounding wall. The surrounding wall may have wire-receiving grooves for passing the wires through the surrounding wall. With such a construction, the wires can be installed within the wire distribution enclosure.

In another aspect of the present teachings, methods are taught for installing the wires without causing the wires to cross each other between an injector independent connecting terminal and injector common connecting terminals of the injectors and an external wiring common connecting terminal and external wiring independent connecting terminals of the external wiring connector. Preferably, such wire installation method include routing a single wire along a wire routing path, connecting the wire to the connecting terminals and removing or cutting out unnecessary or surplus portions of the wire to form a plurality of separate connections. In this case, the wire is routed along a wire routing path, thereby facilitating the wire installation, connection and removal operations. Auxiliary guides are preferably used in the routing step, thereby further facilitating the wire routing operation. The auxiliary guides are preferably not integral with the fuel delivery pipe.

Additional objects, features and advantages of the present invention will be readily understood after reading the following detailed description together with the accompanying drawings and the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a front view of a first representative embodiment of an improved fuel delivery pipe;

FIG. **2** is a rear view of the first representative embodiment;

FIG. **3** is a sectional view taken along line III—III in FIG. **1**;

FIG. **4** is a sectional view taken along line IV—IV in FIG. **1**;

FIG. **5** is a sectional view taken along line V—V in FIG. **4**;

FIG. **6** is a front view of a main body of the first representative embodiment;

FIG. **7** is a sectional view taken along line VII—VII in FIG. **6**;

FIG. **8** is a front view of the main body with wires installed therein;

FIG. **9** is a sectional view taken along line IX—IX in FIG. **8**;

FIG. **10** is a front view of a portion around an external wiring connector;

FIG. **11** is a front view of wires;

FIG. **12** is a rear view of a cover;

FIG. **13** is a sectional view taken along line XIII—XIII in FIG. **12**;

FIG. **14** is a partial sectional view showing a joint of the cover;

FIG. **15** is a partial sectional view showing another example of a joint of the cover;

FIG. **16** is a front view of a second representative embodiment of an improved fuel delivery pipe;

FIG. **17** is a bottom view of the second representative embodiment;

FIG. **18** is a view showing wiring in the second representative embodiment;

FIG. **19** is a front view of a connector block body;

FIG. **20** is bottom view of the connector block body;

FIG. **21** is a sectional view taken along line XX—XX in FIG. **19**;

FIG. **22** is a sectional view taken along line XXI—XXI in FIG. **19**;

FIG. **23** is a front view of a cover;

FIG. **24** is a sectional view taken along line XXIV—XXIV in FIG. **23**;

FIG. **25** is the wiring diagram of the second representative embodiment;

FIG. **26** is a wire routing diagram of the second representative embodiment;

FIG. **27** is a view showing a wire routed along the wire routing path of the second representative embodiment;

FIG. **28** is the wiring diagram of a third representative embodiment;

FIG. **29** is the wiring diagram of a fourth representative embodiment;

FIG. **30** is a wire routing diagram of the fourth representative embodiment;

FIG. **31** is the wiring diagram of a fifth representative embodiment;

FIG. **32** is a wire routing diagram of the fifth representative embodiment;

FIG. **33** is a perspective view of a known fuel delivery pipe; and

FIG. **34** is a sectional view taken along line XXXIV—XXXIV in FIG. **33**.

DETAILED DESCRIPTION OF THE INVENTION

According to the present teachings, wires for connecting the connecting terminals of fuel injectors to an external wiring connector are provided inside the fuel delivery pipe, which are also known in the field as fuel distributors or fuel rails. Such fuel delivery pipes may include a wire distribution enclosure adapted to retain and protect wires connecting an external source to the injectors. Wire guides are preferably provided within the wire distribution enclosure. During the wire installation process, the wires may be wound around or hooked on the wire guides. Preferably, the wire guides may be disposed in a position to change the routing direction of the wires, thereby facilitating the wire installation operation of the wires. In addition or in the alternative, the wiring guides may have walls that partition the wire distribution enclosure into sections and the wires may be separately laid in each of the sections. Thus, the wires can be wound around the wire guides or hooking the wires on the wire guides, or laid the wires separately in each of the sections of the wire distribution enclosure, which has been partitioned by the wire guides. As a result, the wires will not cross each other, thereby reducing or substantially preventing wiring defects, such as breakage or short circuits.

Further, a surrounding wall may be provided to surround the wire distribution enclosure, and the connecting terminals of the injectors may extend through the surrounding wall. The surrounding wall may have wire receiving grooves for passing the wires through the surrounding wall. With such a construction, the wires can be installed within the wire distribution enclosure.

In addition, methods are taught for installing the wires without causing the wires to cross each other. Preferably, a single wire is installed in a single continuous operation along a wire routing path through the injector independent connecting terminals and the injector common connecting terminals of the injectors and the external wiring common connecting terminal and external wiring independent connecting terminals of the external wiring connector. Subsequently, the wire is connected to the connecting terminals. Finally, unnecessary or surplus wire portions (i.e. portions of the wire other than the necessary wire portions) are removed or cut out. In this specification, the term "necessary wires" is intended to mean wires that electrically couple the external connector to the injector connecting terminals in order to supply induction signals from an external source to the injectors. Wires that are not intended for this purpose are called "unnecessary wires."

These methods facilitate the operation of installing the wires without causing the installed wires to cross each other. In addition, auxiliary guides preferably may be used in the routing step in order to thereby further facilitate the wire routing operation.

Representative examples of the present invention will now be described in further detail with reference to the attached drawings. This detailed description is merely intended to teach a person of skill in the art further details for practicing preferred aspects of the present teachings and is not intended to limit the scope of the invention. Only the claims define the scope of the claimed invention. Therefore, combinations of features and steps disclosed in the following detail description may not be necessary to practice the invention in the broadest sense, and are instead taught merely to particularly describe some representative examples of the invention.

First Representative Embodiment

A fuel delivery pipe of a first representative embodiment can be used, for example, in an in-line three-cylinder engine. FIG. **1** is a front view of the fuel delivery pipe; FIG. **2** is a rear view thereof; FIG. **3** is a sectional view taken along line III—III in FIG. **1**; FIG. **4** is a sectional view taken along line IV—IV in FIG. **1**; and FIG. **5** is a sectional view taken along line V—V in FIG. **4**.

The fuel delivery pipe may include a main body **10** that is integrally formed, for example, of a composite resin into which a filler-type short fiber reinforcing material has been mixed. A polyamide resin, such as **66** nylon, is preferably used as the composite resin, and glass fiber is suitably used as the filler-type reinforcing material. A predetermined number of injectors **50** (three in FIG. **1**) are connected to the main body **10**. As shown in FIG. **2**, a connector **18** is provided on the main body **10** and is connected to external wiring (not shown). A plurality of wires **60***a*–**60***f* (see FIG. **8**) are installed in the main body **10** and are connected between each of the injectors **50** and the connector **18**. The injectors **50** are typically coupled to an engine intake manifold (not shown). A variety of known injectors and known engine intake manifolds may be utilized with the present teachings.

As shown in FIGS. **1** and **5**, the main body **10** may include, for example, a body portion **12**, three injector connecting portions **14**, a pair of connecting bosses **16**, an external wiring connector **18**, a wire distribution enclosure **20**, and a cover **40**. The body portion **12** may be generally cylindrical. The three injector connecting portions **14** may be provided on the lower side of the body portion **12** and can connect to the injectors **50** (#1 to #3). The connecting bosses **16** may be provided between the injector connecting portions **14** in order to attach the fuel delivery pipe to a predetermined position of an engine (not shown) by bolts or other fasteners. The external wiring connector **18** preferably is provided on the upper side of the body portion **12** and above the riddle connecting portion **14**. The wires **60***a*–**60***f* (see FIG. **8**) are laid in the wire distribution enclosure **20** and are connected between each of the injectors **50** and the connector **18**. The cover **40** covers the wire distribution enclosure **20**. FIG. **6** is a front view of the main body **10** and FIG. **7** is a sectional view taken along line VII—VII in FIG. **6**.

As shown in FIG.**7**, each of the injector connecting portions **14** preferably has a generally cylindrical stepped configuration with an open bottom. A cylindrical portion **15** may be formed in the lower portion of the connecting portion **14**. A pair of front and rear engagement holes **15***a* may be radially formed through the cylindrical portion **15**. As shown in FIG. **6**, slits **15***b* may be formed on both sides of the engagement holes **15***a* and extend upwardly from the lower end of the cylindrical portion **15**. By providing the slits **15***b*, the diameter of the cylindrical portion **15** can be enlarged around the engagement holes **15***a* and thus the cylindrical portion **15** can radially expand.

As shown in FIG. **5**, the body portion **12** and the injector connecting portions **14** may define a fuel passage **11** through which pressurized fuel is delivered to each injector **50**.

As shown in FIG. **7**, the external wiring connector **18** may be integrally formed in the middle of the upper portion of the main body **10** and may slightly protrude from the main body **10**. The connector **18** may have a generally rectangular socket portion **18***a* with an open rear end.

As shown in FIGS. **6** and **7**, the wire distribution enclosure **20** preferably has a surrounding wall **21** that extends forward of the main body **10** and forms a widthwise elongated rectangular frame. The surrounding wall **21** includes an upper wall portion **22** and lower wall portions **23**. The upper wall portion **22** protrudes upwardly and substantially surrounds the front side of the external wiring connector **18**. Each of the lower wall portions **23** protrudes downwardly and substantially surrounds the front side of the injector connecting portions **14**. The front surface of the main body **10** within the wall **21** (or a bottom surface **20***a* of the wire distribution enclosure **20**) is flat (see FIG. **7**).

As shown in FIG. **7**, the space within the upper wall portion **22** is positioned to correspond to the space within the socket portion **18***a* of the connector **18**. Four holes **19** are formed in juxtaposition (as shown in FIG. **6**) and extend transversely through the main body **10** between the space within the upper wall portion **22** and the space within the socket portion **18***a* of the connector **18**.

As also shown in FIG. **7**, a GND (grounding) terminal plate **25** is provided below the holes **19** and is press-fitted into the bottom surface **20***a* that is within the upper wall portion **22**. Three U-shaped wire engaging grooves **25***a* are formed in the GND terminal plate **25** and engage ends of the wires **60***a*, **60***c*, **60***e*, which will be described below (see FIG. **10**).

As shown in FIGS. **6** and **7**, a lower end portion **23***a* of the lower wall portion **23** also serves as a stepped wall portion of the injector connecting portions **14**. A pair of holes **23***b* (one of which is shown in FIG. **7**) extend vertically through the lower end portion **23***a*.

As shown in FIG. **6**, five partitions **27***a*–**27***e* are preferably provided on the bottom surface **20***a* of the wire distribution enclosure **20** and partition the space within the surrounding wall **21** into six grooves **29***c*–**29***f*. The middle partition **27***c* extends in a generally vertical direction from the lower end portion **23***a* of the middle lower wall portion **23** near the GND terminal plate **25** of the connector **18**. Further, the partitions **27***b*, **27***d* are provided to the right and left of the middle partition **27***c* and extend in a generally vertically direction from the right and left side wall portions of the middle lower wall portion **23** near the GND terminal plate **25** of the connector **18**. The partitions **27***a*, **27***e* are provided on the right and left portions of the bottom surface **20***a* and have a crank shape extending along the wall **21** from the lower end portion **23***a* of the right and left lower wall portions **23** near to the GND terminal plate **25** of the connector **18**.

The partition **27***c* and the partitions **27***b*, **27***d* define vertically extending parallel grooves **29***c*, **29***d* in the center of the wire distribution enclosure **20**. The partitions **27***a* and **27***b* define crank shaped grooves **29***a*, **29***b* that extend side by side along the partitions **27***a*, **27***b* in the left part of the wire distribution enclosure **20**. Further, the partition **27***d* and the partition **27***e* define crank shaped grooves **29***c*, **29***f* that extend side by side along the partitions **27***d*, **27***e* in the right part of the wire distribution enclosure **20**.

As shown in FIG. **5**, after molding the main body **10**, a sealing plug **30** is fitted into an opening of one end (the left end as viewed in FIG. **5**) of the body portion **12** through an O-ring **31**. A sealing cap **32** is then fixed to the end of the body portion **12**, for example, by deposition. Further, a retainer **34** for a quick connector is mounted on an opening of the other end (the right end as viewed in FIG. **5**) of the body portion **12**.

As shown in FIGS. **8** to **10**, four external wiring connecting terminals **36** may be inserted through the holes **19** (see FIG. **6**) of the main body **10**. A U-shaped wire engaging groove **36***a* is formed in one end of each external wiring connecting terminal **36** on the side of the wire distribution enclosure **20**. The engaging grooves **36***a* receive the ends of the wires **60***b*, **60***c*, **60***d*, **60***f*. Of the four external wiring connecting terminals **36**, the second one from the left in FIG. **10** is used as a common connecting terminal for grounding, and the remaining three terminals **36** are used as independent connecting terminals for coupling driving or induction signals to the injectors **50**.

As shown in FIG. **9**, a fuel supply side opening end **51** of the injector **50** is connected to the injector connecting portion **14** of the main body **10** by an O-ring **52**. The cylindrical portion **15** of the injector connecting portion **14** receives a resin connector portion **55** fitted around a core **54** of the injector **50**.

When the injector **50** is inserted into the injector connecting portion **14**, a pair of engagement projections **55***a* formed in the outer surface of the connector portion **55** engage the engagement holes **15***a* due to elastic deformation of the portion of the cylindrical portion **15** in which slits **15***b* (see FIG. **6**) are formed. Thus, the injector **50** can be readily connected to the injector connecting portion **14** by snap-fitting.

As shown in FIGS. **8** and **9**, two injector connecting terminals **57** are provided in the connector portion **55** of each

injector **50** and project upwardly. When the connecting terminals **57** are press-fitted into the holes **23***b* formed in the lower end portion **23***a* (see FIG. **6**) of the lower wall portion **23** of the wire distribution enclosure **20**, the distal end (upper end) of each connecting terminal **57** extends into the wire distribution enclosure **20**. A packing or gasket **58** is disposed between the lower end portion **23***a* of the lower wall portion **23** and the connector portion **55** and around each connecting terminal **57**. One of the two injector connecting terminals **57** (the left one in FIG. **8**) is used as a common connecting terminal for grounding, and the other or right one is used as an independent connecting terminal for supplying driving or induction signals to the injectors.

The wires **60***a*–**60***f*, which will be described in further detail below, connect the four connecting terminals **36** and the GND terminal plate **25** to the connecting terminals **57** of each injector **50**. As shown in FIG. **11**, the wires **60***a*–**60***f* comprise two short wires **60***c*, **60***d* disposed in the middle, two long wires **60***a*, **60***b* on the left, and two long wires **60***e*, **60***f* on the right. With respect to each pair of the wires **60***a* and **60***b*, **60***c* and **60***d*, **60***e* and **60***f*, the left wires **60***a*, **60***c*, **60***e* are used for grounding, and the right wires **60***b*, **60***d*, **60***f* are used for supplying driving or induction signals to the injectors.

As shown in FIG. **8**, the wires **60***c*, **60***d* are laid within the vertical grooves **29***c*, **29***d* formed in the center of the wire distribution enclosure **20**. The wires **60***a*, **60***b* are laid within the crank shaped grooves **29***a*, **29***b* in the left part of the wire distribution enclosure **20**. The wires **60***e*, **60***f* are laid within the crank shaped grooves **29***e*, **29***f* in the right part of the wire distribution enclosure **20**. The wires **60***a*, **60***b*, **60***e*, **60***f* may be formed to correspond to the crank configuration of the grooves **29***a*, **29***b*, **29***e*, **29***f*.

As shown in FIG. **10**, the upper ends of the wires **60***a*, **60***c*, **60***e* for grounding are resistance welded or soldered in engagement with the wire engagement grooves **25***a* of the GND terminal plate **25**. The upper end of the middle wire **60***c* is further resistance welded or soldered in engagement with the wire engagement groove **36***a* of the second connecting terminal **36** from the left. Further, the upper ends of the wires **60***b*, **60***d*, **60***f* for supplying driving or induction signals to the injectors are resistance welded or soldered in engagement with the wire engagement grooves **36***a* of the first, third and fourth connecting terminals **36** from the left, respectively.

As shown in FIG. **8**, the lower ends of the wires **60***a*–**60***f* are resistance welded or soldered to the associated injector connecting terminals **57** of the injectors **50**.

The cover **40**, which will now be described in further detail, covers the wire distribution enclosure **20** in which the wires **60***a*–**60***f* have been installed in the manner as described above. The cover **40** is shown in FIGS. **12** and **13**. FIG. **12** is a rear view of the cover **40**, and FIG. **13** is a sectional view taken along line XIII—XIII in FIG. **13**. The cover **40** has a flat plate-like shape that generally has the same contour as the upper edge of the surrounding wall **21** (see FIG. **6**) of the wire distribution enclosure **20**.

As shown in FIG. **12**, ribs **42***a*, **42***b*, **42***c*, **42***d*, **42***e* are formed to correspond to the partitions **27***a*, **27***b*, **27***c*, **27***d*, **27***e* of the wire distribution enclosure **20**, respectively, on the back surface of the cover **40**. The cover **40** preferably is integrally formed of the same resin material that is used for the main body **10**. The ribs **42***a*–**42***e* of the cover contact the partitions **27***a*–**27***e* of the wire distribution enclosure **20**. In this state, the outer periphery of the cover **40** is joined to the open end surface of the surrounding wall **21**, for example, by adhesives or by deposition. Thus, the wire distribution enclosure **20** in which the wires **60***a*–**60***f* have been installed is covered.

Thus, mounting the cover **40** on the main body **10** will complete the assembly of the fuel delivery pipe. Alternatively, the fuel delivery pipe may also be completed by filling the wire distribution enclosure **20** of the main body **10** with a potting resin. In this case, the same wire covering effect can be obtained.

Further, as shown in FIG. **5**, a fuel supply pipe **70** (shown by a broken line) is easily inserted in a continuous motion into the right end opening of the main portion **12** through the quick-connector retainer **34**.

Bolts or other fasteners may be utilized to attach the connecting bosses **16** to a predetermined position of the engine block (not shown). At this time, the wire distribution enclosure **20** is downwardly oriented. Further, fuel injection signals are supplied to a power supply connector (not shown) by external wiring, which power supply connector is connected to the external wiring connector **18** shown in FIG. **2**.

As described above, in the fuel delivery pipe of this embodiment, the wires **60***a*–**60***f* are installed in the wire distribution enclosure **20** of the main body **10** and the cover **40** covers the main body **10**. Therefore, unlike known fuel delivery pipes, in which the wires **60***a*–**60***f* are embedded or installed in the main body **10** by injection molding, high molding pressure is not exerted on the wires **60***a*–**60***f*, thereby preventing the wires **60***a*–**60***f* from becoming distorted by high molding pressure. As a result, wiring defects caused by high pressure molding, such as wire distortion, breakage, short circuits or exposure of the wires on the outer surface of the main body **10**, do not occur. Further, the partitions **27***a*–**27***e* of the wire distribution enclosure **20** can separate the wires **60***a*–**60***f* from each other, thereby ensuring insulation of the wires.

Further, as described above in this embodiment, the connecting terminals **36** may be press-fitted into the connector **18**. Therefore, unlike known fuel delivery pipes, in which the connecting terminals **36** are formed in the main body **10** by injection molding, high molding pressure is not exerted on the connecting terminals **36**, thereby preventing the connecting terminals **36** from becoming distorted by high molding pressure.

Moreover, because the wires **60***a*–**60***f* within the wire distribution enclosure **20** are connected to the injector connecting terminals **57** of the injectors **50**, it is not necessary to provide terminals for the injector connectors, which are necessary if the injectors **50** are detachably connected to the fuel delivery pipe. Thus, the number of components and assembling man-hours can be reduced.

The cover **40** may be snap-fitted on the surrounding wall **21** of the main body **10**. For example, as shown in FIG. **15**, at least two engagement pieces **44**, each having an engagement claw **44***a*, may extend from the outer peripheral portion of the cover **40** and can elastically deform. An engagement claw **46** is formed on the outside surface of the wall **21** of the wire distribution enclosure **20** and can engage the engagement claws **44***a* of the cover **40**. In order to attach the cover **40** to the wall **21** of the wire distribution enclosure **20**, the cover **40** is pressed against die wall **21**. At this time, the engagement claws **44***a* are elastically deformed and pass over the engagement claw **46**, thus engaging the engagement claw **46**. By thus snap-fitting the cover **40** to the wall **21**, the cover **40** can be more readily attached to the main body **10** with a single motion as compared to the above representa-

tive embodiment in which the cover **40** is joined to the wall **21**, for example, by adhesives or by deposition.

The present teachings are not limited to the constructions that have been described in the first representative embodiment, but rather, may be appropriately modified without departing from the spirit and scope of the invention. For example, while the first representative embodiment is a fuel delivery pipe for an in-line three-cylinder engine, the number of cylinders is not limited. Further, although each of the partitions **27***a*–**27***e* is contiguous, the partitions may be discontinuous, for example, in the form of discontinuous walls or projections. Further, the wires **60***a*–**60***f* may be formed of a conductor coated with an insulating material. In this case, it is not necessary to provide the partitions **27***a*–**27***c*.

Second Representative Embodiment

A fuel delivery pipe of a second representative embodiment also can be used, for example, in an in-line three-cylinder engine and has a connector block for injector. FIG. **16** is a front view of the fuel delivery pipe, and FIG. **17** is a bottom view of the fuel delivery pipe.

The fuel delivery pipe of the second representative embodiment may include a connector block body **130** and a cover **138**. The cover **138** is mounted on the front of the connector block body **130** (frontward as viewed in FIG. **16**). FIG. **18** is a view showing the wiring in the connector block body **130**; FIG. **19** is a front view of the connector block body **130**; FIG. **20** is bottom view thereof; FIG. **21** is a sectional view taken along line XX—XX in FIG. **19**; and FIG. **22** is a sectional view taken along line XXI—XXI in FIG. **19**.

As shown in FIGS. **19** to **21**, the connector block body **130** may mainly comprise a generally cylindrical pipe portion **131**. A fuel supply passage **132** (see FIG. **21**) is defined within the hollow space inside of the pipe portion **131**. The connector block body **130** is preferably formed, for example, of a composite resin into which a filler-type short fiber reinforcing material has been mixed. A polyamide resin, such as 66 nylon, preferably may be used as the composite resin, and glass fiber preferably may be used as the filler-type reinforcing material.

A fuel supply pipe connecting portion **131***a* is integrally formed on one end (the right end as viewed in FIG. **19**) of the pipe portion **131** and radially extends from the pipe portion **131** (downward as viewed in FIGS. **19** and **20**). A fuel supply pipe (not shown) is connected to the fuel supply pipe connecting portion **131***a* and serves to supply fuel to the fuel supply passage **132** (see FIG. **21**) of the pipe portion **131**. The open end on the other end (the left end as viewed in FIG. **19**) of the pipe portion **131** is sealed by a sealing cap **139**. The sealing cap **139** is fixed to the pipe portion **131**, for example, by heat deposition or by adhesives.

As shown in FIG. **20**, right and left bosses **133** may be integrally formed on the back side (the lower side as viewed in FIG. **20**) of the pipe portion **131**. The bosses **133** preferably attach the fuel delivery pipe to the engine block (not shown) using bolts or other fasteners.

Three injector connecting portions **141**, **142**, **143** are integrally formed on the lower side of the pipe portion **131**. Each of the injector connecting portions **141**–**143** has a generally cylindrical shape with an open lower end and communicates with the pipe portion **131**.

Three injectors **105** (**#1** to **#3**) are snap-fitted into the respective injector connecting portions **141** to **143**. Fuel is supplied from the pipe portion **131** to the injectors **105**.

As shown in FIG. **19**, a pair of injector connecting terminals **101***a* and **101***b*, **102***a* and **102***b*, **103***a* and **103***b* is provided on each of the respective injectors **105** (**#1** to **#3**). As shown in FIG. **22**, the injector connecting terminals **102***b* (**101***a*, . . .) extend through a lower end portion **135***b* of a surrounding wall **135** formed on the connector block body **130**. Thus, the injector connecting terminals **102***b* (**101***a*, . . .) are inserted into the inside of the wall **135**. A packing or gasket **108** is disposed between the lower end portion **135***b* of the wall **135** and each of the injectors **105** and is fitted around the injector connecting terminal **102***b*.

One of the two injector connecting terminals for each injector **105** is used as an injector independent connecting terminal for supplying driving signals to the injector **105**, while the other is used as an injector common connecting terminal. More specifically, injectors **#1**, **#2** have injector independent connecting terminals **101***a*, **102***a* for supplying driving or induction signals to the injectors that are disposed on the right, and the injector common connecting terminals **101***b*, **102***b* that are disposed on the left. Injector **#3** has the injector independent connecting terminal **103***a* for supplying driving or induction signals to the injectors that is disposed on the left, and the injector common connecting terminal **103***b* that is disposed on the right (see the wiring diagram of FIG. **25**).

An external wiring connector **150** is integrally formed in the middle of the pipe portion **131**. The connector **150** has a generally rectangular socket portion **150***a* with an open rear end (right end in FIG. **21**). The connector **150** is positioned generally above the second injector connecting portion **142**. A connector that is connected to external wiring is connected to the socket portion **150***a*.

As shown in FIG. **19**, four external wiring connecting terminals **151**, **152**, **153**, **158** are provided in the connector **150** and are preferably disposed in a row that is generally parallel to the row of the injectors.

As shown in FIG. **21**, the external wiring connecting terminal **158** (**151** to **153**) extends transversely (from the left to the right as viewed in FIG. **21**) through the connector **150**. The rear end (the right end as viewed in FIG. **21**) of the connecting terminal **158** (**151** to **153**) is disposed within the socket portion **150***a*. The front end (the left end as viewed in FIG. **21**) of the connecting terminal **158** (**151** to **153**) is bent downward generally along the bottom surface of a wire distribution groove **136**.

Of the four external wiring connecting terminals **151** to **153**, **158**, the second terminal **158** from the left in FIG. **19** is used as an external wiring common connecting terminal for grounding, and the remaining three connecting terminals **151** to **153** are used as external wiring independent connecting terminals for supplying driving or induction signals to the injectors. The external wiring common connecting terminal **158** is wider than the external wiring independent connecting terminals **151** to **153**. Further, as shown in FIG. **22**, a generally pin-shaped wiring guide **158***a* extends from the front end portion (the left end portion as viewed in FIG. **22**) of the common connecting terminal **158**. A wire retainer **158***b* is formed on and extends in generally vertical direction from the end of the wire guide **158***a* and basically has a T-shape.

As shown in FIG. **19**, a surrounding wall **135** extends forward and forms a widthwise elongated rectangular frame. The surrounding wall **135** includes an upper wall portion **135***a* and lower wall portions **135***b*. The upper wall portion **135***a* protrudes upwardly and formed to correspond to the external wiring connector **150**. The lower wall portions **135***b*

protrude downwardly and are formed to correspond to the injector connecting portions **141** to **143**. A recessed portion within the surrounding wall **135** comprises a wire distribution groove **136** in which wires are laid.

Wire receiving grooves **137** are formed (vertically as viewed in FIG. **19**) across the upper wall portion **135***a* and the lower wall portions **135***b* of the surrounding wall **135**. Three wire receiving grooves **137** are formed in the upper wall portion **135***a* and are positioned substantially directly above the first to third external wiring independent connecting terminals **151** to **153**. Six wire receiving grooves **137** are formed in the lower wall portions **135***b* and are positioned substantially directly below the injector independent connecting terminals **101***a*, **102***a*, **103***a* and the injector common connecting terminals **101***b*, **102***b*, **103***b*.

As shown in FIG. **22**, the wire receiving grooves **137** are open to the front end surface (the left end surface as viewed in FIG. **22**) and can receive the wires across the wall portions **135***a*, **135***b* of the surrounding wall **135**. Each bottom surface **137***a* of the wire receiving grooves **137** is inclined inwardly from the outside to the inside (the side of the wire distribution groove **136**) of the wall portions **135***a*, **135***b* of the surrounding wall **135** such that the grooves **137** become deeper.

As shown in FIG. **19**, a plurality of partitions **160** (four in this embodiment) are formed on the bottom surface of the wire distribution groove **136** and extend discontinuously along a longitudinally extending line. Two partitions **160** are disposed on each of the right and left sides of the external wiring connector **150** provided in the middle and thus substantially divide the inside of the wire distribution groove **136** into upper and lower halves.

Fourteen wiring guides **161** to **174** are provided on the bottom surface of the wire distribution groove **136** and are arranged irregularly from the left to the right in this order. In FIG. **19**, the wire guides **161** and **162** are disposed generally above the injector connecting terminals **101***a*, **101***b* of the injector #**1**. The wire guide **163** is disposed at about a medial position between the external wiring independent connecting terminal **151** and the right end of the partition **160** that is disposed to the left of the terminal **151**. The wire guide **164** is disposed on the upper left of the independent connecting terminal **151**. The wire guide **165** is disposed generally below the independent connecting terminal **151**. The wire guide **166** is disposed on the upper left of the common connecting terminal **158**.

The wire guide **167** is disposed at about a medial position between the external wiring common connecting terminal **158** and the injector common connecting terminal **102***b* of the injector #**2**. The wire guide **168** is disposed on the upper right of the common connecting terminal **158**. The wire guide **169** is disposed at about a medial position between the independent connecting terminal **152** and the injector independent connecting terminal **102***a* of the injector #**2**. The wire guide **170** is disposed generally below the independent connecting terminal **153**. The wire guide **171** is disposed on the upper right of the independent connecting terminal **153**. The wire guide **172** is disposed at about a medial position between the independent connecting terminal **153** and the left end of the partition **160** that is situated to the right of the terminal **153**. The wire guides **173**, **174** are disposed generally above the respective connecting terminals **103***a*, **103***b* of the injector #**3**. Each of the wire guides **161** to **174** is disposed in a position to change the routing direction of wires **11** to **13** (which will be described below)(see FIG. **18**).

As shown in FIG. **19**, the wire guides **163**, **172** are generally cylindrical and the remaining wiring guides are generally rectangular. Further, as shown in FIG. **22**, an upwardly protruding wire retainer **166***a* is formed in the end of the wire guide **166**. Similar upwardly protruding wire retainers (not shown) are also formed in the end of the wire guides **161**, **162**, **164**, **168**, **171**, **173**, **174**. Further, downwardly protruding wire retainers **165***a*, **167***a* are formed in the end of the wire guides **165**, **167**. Similar downwardly protruding wire retainers (not shown) are also formed in the end of the wire guides **161**, **169**, **170**.

As shown in FIG. **25**, the three independent wires **111** to **113** and the three common wires **121** to **123** are connected to the injector connecting terminals **101***a*, **101***b*, **102***a*, **102***b*, **103***a*, **103***b* on one end and the other ends are all routed to the connector **150**. The wires **111** to **113**, **121** to **123** are installed in generally the same plane so as not to cross each other, in a manner that will be described in further detail below. The wires **111** to **113**, **121** to **123** are, for example, magnet wires. The ends of the wires are connected to the injector connecting terminals **101***a*, **101***b*, **102***a*, **102***b*, **103***a*, **103***b* of the injectors #**1** to #**3** and the connecting terminals **151** to **153**,**158** of the connector **150**, for example, by soldering, ultrasonic deposition, resistance welding or similar fastening processes.

Specifically, as shown in FIG. **25**, one end of the first independent wire **111** is connected to the injector independent connecting terminal **101***a* of the injector #**1**, while the other end is routed from the injector side of the external wiring connecting terminal row (from below as viewed in FIG. **25**) and connected to the external wiring independent connecting terminal **151**. One end of the second independent wire **112** is connected to the injector independent connecting terminal **102***a* of the injector #**2**, while the other end is routed from the injector side of the external wiring connecting terminal row (from below as viewed in FIG. **25**) and connected to the independent connecting terminal **152**. One end of the third independent wire **113** is connected to the injector independent connecting terminal **103***a* of the injector #**3**, while the other end is routed from the injector side of the external wiring connecting terminal row (from below as viewed in FIG. **25**) and connected to the independent connecting terminal **153**.

One end of the common wile **121** is connected to the injector common connecting terminal **101***b* of the injector #**1**, while the other end is routed from the side opposite to the injector side of the external wiring connecting terminal row (from above as viewed in FIG. **25**) and connected to the common connecting terminal **158**. Specifically, the first common wire **121** takes a detour from above the first connecting terminal **151** or from the side opposite to the injector side. One end of the second common wire **122** is connected to the injector common connecting terminal **102***b* of the injector #**2**, while the other end is routed from the injector side of the external wiring connecting terminal row (from below as viewed in FIG. **25**) and connected to the common connecting terminal **158**. In this embodiment, the common wires **121** and **122** are integrated into one wire across the common connecting terminal **158**. One end of the third common wire **123** is connected to the injector common connecting terminal **103***b* of the injector #**3**, while the other end is routed from the side opposite to the injector side of the external wiring connecting terminal row (from above as viewed in FIG. **25**) and connected to the common connecting terminal **158**. Specifically, the common wire **123** takes a detour from above the connecting terminals **152**, **153** or from the side opposite to the injector side.

Further, as shown in FIG. **18**, the independent wire **111** is disposed within the lower half of the groove **136** that is

partitioned by the partitions **160** in the left half of the groove **136** inside the surrounding wall **135**. The independent wire **111** is routed through the wire guides **162, 165**. The independent wire **112** is routed through the wire guide **169**. The independent wire **113** is disposed within the lower half of the groove **136** that is partitioned by the partitions **160** in the right half of the groove **136** inside the surrounding wall **135**. The independent wire **113** is routed through the wire guides **170, 173**.

The common wire **121** is disposed within the upper half of the groove **136** that is partitioned by the partitions **160** in the left half of the groove **136** inside the surrounding wall **135**. The common wire **121** is routed through the wire guides **161, 163, 164, 166**. The common wire **122** is routed through the wire guide **167**. The common wire **123** is disposed within the upper half of the groove **136** that is partitioned by the partitions **160** in the right half of the groove **136** inside the surrounding wall **135**. The common wire **123** is routed through the wire guide **158***a* of the external wiring common connecting terminal **158** and through the wire guides **168, 171, 172, 174**.

The wire guide **158***a* of the external wiring common connecting terminal **158** and the wire guides **161, 162, 165** to **170, 173, 174** in this embodiment correspond to "wiring guides around which wires are wound" in this specification. The wires are wound about one and a half turns around the wire guides. Further, the wire guides **163, 164, 171, 172** correspond to "wiring guides on which wires are hooked." The wires are hooked on these wiring guides. The wires may also be wound more than one turn around the wire guides **163, 164, 171, 172**.

The wire retainers (**158***b*, **165***a*, **166***a*, **167***a* (see FIG. **22**)) of the wire guides **158***a*, **161, 162, 164** to **171, 173, 174** prevent the wires **111** to **113**, **121** to **123** from being removed from the wire guides.

The independent wires **111** to **113** and the common wires **121** to **123** are installed using a method of installing the wires that will now be explained in further detail. The wire installing method includes the steps of routing the wires, connecting the wires and removing or cutting out unnecessary or surplus wires.

In the routing step, as shown in FIG. **27**, a wire **110** is routed along a wire routing path through each of the wire guides **158***a*, **161** to **174** of the connector block body **130**, the independent connecting terminals **101***a*, **102***a*, **103***a* and the common connecting terminals **101***b*, **102***b*, **103***b* of the injectors **#1** to **#3**, the independent connecting terminals **151** to **153** and the common connecting terminal **158** of the external wiring connector **150**, and six auxiliary guides **181** to **186**. The wire **110** preferably may be installed in a single continuous operation along the wire routing path. A known automatic wiring machine can be used to install the wire **110**. An appropriate automatic wiring machine is sold by Fanuc as model LRMET, although other automatic wire machines may be utilized with the present teachings. In the wire routing diagram of FIG. **26**, portions of the wire **110** that form the independent wires **111** to **113** are shown by fine lines and portions of the wire **110** that form the common wires **121** to **123** are shown by heavy lines. The wire portions shown by fine lines and heavy lines are necessary wire portions. The remaining wire portions shown by dotted lines are unnecessary or surplus wire portions **110***a*. Both independent wires **111–113** and common wires **121–123** may be the same type of wire or may be different types of wires.

As shown in FIG. **27**, six generally rod-like auxiliary guides **181** to **186** are positioned around the connector block body **130**. The six auxiliary guides **181** to **186** are vertically disposed on a work support base of an automatic wiring machine (not shown). A preferred arrangement for the auxiliary guides is as follows. The auxiliary guide **181** is disposed below the independent connecting terminal **151**. The auxiliary guide **182** is disposed below the injector **#3**. The auxiliary guide **183** is disposed above the external wiring independent connecting terminals **152, 153**. The auxiliary guide **184** is disposed below the injector **#2**. The auxiliary guide **185** is disposed below the injector **#1**. The auxiliary guide **186** is disposed above the independent connecting terminal **151**.

As shown in FIGS. **26** and **27**, the wire **110** is installed by the automatic wiring machine routing the wire from a starting point S of the auxiliary guide **181** back to an ending point E of the auxiliary guide **181**. The wire **110** preferably passes through the external wiring common connecting terminal **158**, the common connecting terminal **103***b* of the injector **#3**, the auxiliary guide **182**, the independent connecting terminal **103***a* of the injector **#3**, the independent connecting terminal **153**, the auxiliary guide **183**, the independent connecting terminal **152**, the independent connecting terminal **102***a* of the injector **#2**, the auxiliary guide **184**, the common connecting terminal **102***b* of the injector **#2**, the common connecting terminal **158**, the common connecting terminal **101***b* of the injector **#1**, the auxiliary guide **185**, the independent connecting terminal **101***a* of the injector **#1**, the independent connecting terminal **151** and the auxiliary guide **186** in this order.

During the wire installation process, the wire **110** is routed using a predetermined tension while being wound around the wire guides **158***a*, **161, 162, 165** to **170, 173, 174** and hooked on the wire guides **163, 164, 171, 172**. While leading the wire **110** out of and into the wire distribution groove **136**, the wire **110** is received in the wire receiving grooves **137** across the wall portions **135***a*, **135***b* of the surrounding wall **135** of the connector block body **130**. As shown in FIG. **27**, portions of the wire **110** extend between the auxiliary guides **181** to **186** and the wire guides **161, 162, 165, 167, 169, 170, 173, 174** and are routed across the independent connecting terminals **101***a*, **102***a*, **103***a* and the common connecting terminals **101***b*, **102***b*, **103***b* of the injectors **#1** to **#3** and the independent connecting terminals **151** to **153** and the common connecting terminal **158** of the external wiring connector **150**.

Subsequently, in the wire connecting step, the wire **110** is connected to the connecting terminals **101***a*, **102***a*, **103***a*, **101***b*, **102***b*, **103***b*, **151**, **152**, **153**, **158**, for example, by soldering, ultrasonic deposition, resistance welding or similar fastening processes.

Subsequently, in the wire removal step, unnecessary or surplus wire portions **110***a* (see FIG. **26**) are removed or cut out by a cutting device in the automatic wiring machine (not shown), which unnecessary wire portions **110***a* are portions of the wire **110** other than the necessary wire portions (the independent wires **111** to **113** and the common wires **121** to **123**) that are connected between the independent connecting terminals **101***a*, **102***a*, **103***a* and the common connecting terminals **101***b*, **102***b*, **103***b* of the injectors **#1** to **#3** and the independent connecting terminals **151** to **153** and the common connecting terminal **158** of the external wiring connector **150**. Thus, as shown in FIG. **18**, the installation of the wires **111** to **113**, **121** to **123** with respect to the connector block body **130** is completed.

As shown in FIGS. **16** and **17**, the cover **138** covers the wire distribution groove **136** in which the wires **111** to **113**,

121 to **123** have been installed. FIG. **23** is a front view of the cover **138** and FIG. **24** is a sectional view taken along line XXIV—XXIV in FIG. **23**.

The cover **138** may comprise an identical of similar material as the connector block body **130** and preferably has a plate-like shape. The contour of the cover **138** is formed to generally corresponding to the surrounding wall **135** of the connector block body **130**. Further, a rib **138***a* is integrally formed to correspond to the surrounding wall **135** on the outer peripheral edge of the back of the cover **138**. The rib **138***a* of the cover **138** is fitted on the surrounding wall **135** and joined to the connector block body **130**, for example, by vibration deposition or by adhesives. The assembly of the fuel delivery pipe is completed when the cover **138** is placed on the wire distribution groove **136**.

As described above, the fuel delivery pipe of this representative embodiment has wires **111** to **113**, **121** to **123** that are wound around the wire guides **158***a*, **161**, **162**, **165** to **170**, **173**, **174** while being connected between the independent connecting terminals **101***a*, **102***a*, **103***a* and the common connecting terminals **101***b*, **102***b*, **103***b* of the injectors **#1** to **#3** and the independent connecting terminals **151** to **153** and the common connecting terminal **158** of the external wiring connector **150**. Therefore, the wires **111** to **113**, **121** to **123** can be securely installed.

Also, the wire guides **163**, **164**,**171**, **172** on which the wires **111** to **113** are hooked are also provided in the connector block body **130** and thus, can be used in combination with the wire guides **158***a*, **161**, **162**, **165** to **170**, **173**, **174** around which the wires **121** to **123** are wound.

Each of the wire guides **161** to **174** is disposed in a position to change the wiring direction of the wires **111** to **113**, thereby permitting a change in the wiring direction of the wires **111** to **113**.

Further, by providing the wire retainers (**158***b*, **165***a*, **166***a*, **167***a*) in the wire guides **158***a*, **161**, **162**, **164** to **171**, **173**, **174**, the wires **111** to **113** and **121** to **123**, which are wound around or hooked on the wire guides, can be prevented from being removed from the wire guides.

By routing the wire **121** (including the wire **122**) across the common connecting terminal **158** of the external wiring connector **150**, the wire **121** can be readily connected to the common connecting terminal **158**.

Further, because the wire receiving grooves **137** receive the wire **110** across the wall portions **135***a*, **135***b* of the surrounding wall **135**, the wire **110** can be led through the grooves **137** near to the bottom surface of the wire distribution groove **136** of the connector block body **130**.

By routing the wire **110** in one continuous operation along the wire routing path in the wire routing step, the routing operation can be facilitated and routing the wire **110** in one continuous operation along the wire routing path in the wire routing step can reduce the time required for the wire installation operation.

The steps of routing the wires, connecting the wires and removing or cutting out unnecessary or surplus wires can be performed for an entire connector block in a single operation, which permits easy control of the automatic wiring machine.

By using the auxiliary guides **181** to **186** that are provided on the work support base (not shown) of the automatic wiring machine for wiring the wire **110**, the wire **110** can be easily routed.

If the auxiliary guides **181** to **186** are not used, wiring guides should be provided in the connector block body **130** as a substitute for the auxiliary guides **181** to **186**. In such a case, the connector block body **130** may become larger in size. In this embodiment, however, such wire guides are not necessary, so that the connector block body **130** can be smaller.

Further, in the wire routing step, portions of the wire **110** which extend between the auxiliary guides **181** to **186** and the wire guides **161**, **162**, **165**, **167**, **169**, **170**, **173**, **174**, are routed across the independent connecting terminals **101***a*, **102***a*, **103***a* and the common connecting terminals **101***b*, **102***b*, **103***b* of the injectors **#1** to **#3** and the independent connecting terminals **151** to **153** and the common connecting terminal **158** of the external wiring connector **150**. Therefore, such portions of the wire **110** that extend between the auxiliary guides **181** to **186** and the wire guides **161**, **162**, **165**, **167**, **169**, **170**, **173**, **174** can be readily connected to the connecting terminals **101***a*, **102***a*, **103***a*, **101***b*, **102***b*, **103***b*, **151** to **153**, **158**.

By providing an injector connector block in a fuel supply system that includes injectors, a fuel pump and a fuel delivery pipe, the wires **111** to **113**, **121** to **123** can be securely connected and the occurrence of short-circuits in the connector block body **130** can be reduced or prevented.

By forming the fuel supply passage **132** integrally in the connector block body **130**, a fuel delivery pipe can be provided in which the wires **111** to **113**, **121** to **123** can be securely connected and the occurrence of short-circuits in the connector block body **130** can be reduced or prevented.

Further, in the fuel delivery pipe of this representative embodiment, the independent wires **111** to **113** are connected to the independent connecting terminals **101***a*, **102***a*, **103***a* of the injectors **#1** to **#3** on one end, while the other ends are connected from the injector side to the independent connecting terminals **151** to **153** of the external wiring connector **150**. The common wires **121** to **123** are connected to the common connecting terminals **101***b*, **102***b*, **103***b* of the injectors **#1** to **#3** on one end. The other end of the common wire **122** is connected from the injector side to the common connecting terminal **158** of the external wiring connector **150**, while the other ends of the common wires **121**, **123** are routed from the side opposite to the injector side and connected to the common connecting terminal **158**. Thus, the independent wires **111** to **113** and the common wires **121** to **123** can be installed without crossing each other, thereby preventing the wires in the connector block from short-circuiting.

The wires **111** to **113**, **121** to **123** are installed in generally the sane plane, thereby preventing the thickness of the connector block from increasing as compared to a wire installation process in which the wires cross each other.

Further, the wires **111** to **113**, **121** to **123** are separated from each other by the partitions **160** in the wire distribution groove **136**, so that the wires **111** to **113**, **121** to **123** can be reliably insulated from each other.

In addition, the wires **111** to **113**, **121** to **123** are directly connected to the connecting terminals **101***a*, **101***b*, **102***a*, **102***b*, **103***a*, **103***b* of the injectors **#1** to **#3**. Therefore, it is not necessary to provide relay terminals for connecting the injector side ends of the wires **111** to **113**, **121** to **123** to the connecting terminals **101***a*, **101***b*, **102***a*, **102***b*, **103***a*, **103***b* of the injectors **#1** to **#3**. However, the present teachings may also be applied to a fuel delivery pipe having a relay terminal.

Moreover, the wires **111** to **113**, **121** to **123** are installed within the wire distribution groove **136** of the connector block body **130**, which groove is covered by the cover **138**.

Therefore, unlike known fuel delivery pipes, in which the wires **111** to **113**, **121** to **123** are formed in the connector block body **130** by injection molding, warping of the connector block body **130** or distortion of the wires **111** to **113**, **121** to **123** can be prevented. Warping may be caused by differential thermal expansion between the connector block body **130** and the wires **111** to **113**, **121** to **123**.

Third Representative Embodiment

A third representative embodiment will now be explained in further detail with reference to the wiring diagram of FIG. **28**. The third representative embodiment is a modification of the second representative embodiment, and only changed or modified portions will be discussed. Parts identical or substantially identical to those in the second embodiment are given like numerals as in the second embodiment. Also, with respect to the following representative embodiment, overlapping description will be omitted. In FIG. **28**, wires on the side of the independent connecting terminals are shown by fine lines, while wires on the side of the common connecting terminals are shown by heavy lines.

In the third representative embodiment, the locations of the independent connecting terminal **103***a* and the common connecting terminal **103***b* of the injector #**3** in the second embodiment are swapped. Also in this case, one end of the independent wire **113** is connected to the independent connecting terminal **103***a* of the injector #**3**, while the other end is connected from the injector side of the external wiring connecting terminal row (from below as viewed in FIG. **28**) to the independent connecting terminal **153**. One end of the common wire **123** is connected to the injector common connecting terminal **103***b* of the injector #**3**, while the other end is connected from the side opposite to the injector side of the external wiring connecting terminal row (from above as viewed in FIG. **28**) to the common connecting terminal **158**. Specifically, the common wire **123** takes a detour from above the connecting terminal **152** or from the side opposite to the injector side of the connecting terminal **152**.

Also, in this third representative embodiment, the wires **111** to **113**, **121** to **123** can be installed without crossing each other between the independent connecting terminals **101***a*, **102***a*, **103***a* and the common connecting terminals **101***b*, **102***b*, **103***b* of the injectors #**1** to #**3**, and the independent connecting terminals **151** to **153** and the common connecting terminal **158** of the external wiring connector **150**.

Fourth Representative Embodiment

A fourth representative embodiment will now be explained in further detail with reference to the wiring diagram of FIG. **29** and the wire routing diagram of FIG. **30**. In FIGS. **29** and **30**, wires on the side of the independent connecting terminals are shown by fine lines, while wires on the side of the common connecting terminals are shown by heavy lines. In FIG. **30** (and FIG. **32**), unnecessary or surplus wire portions **110***a* are shown by dotted lines, and auxiliary guides are shown by circles.

The fourth representative embodiment is a fuel delivery pipe for an in-line four cylinder engine and has four injectors #**1** to #**4** arranged from the left to the right in this order. In the injectors #**1**, #**3**, independent connecting terminals **101***a*, **103***a* are disposed on the right, while common connecting terminals **101***b*, **103***b* are disposed on the left. In the injectors #**2**, #**4**, independent connecting terminals **102***a*, **104***a* are disposed on the left, while common connecting terminals **102***b*, **104***b* are disposed on the right.

In the external wiring connector **150**, five external wiring connecting terminals **151** to **154**, **158** are disposed along the external wiring connecting terminal row that is generally parallel to the injector row. With the exception of the centrally located terminal **158**, the connecting terminals **151** to **154** are used as external wining independent connecting terminals for supplying driving signals to the injectors #**1** to #**4**. The centrally located connecting terminal **158** is used as an external wiring common connecting terminal.

The independent wires **111** to **114** are connected to the independent connecting terminals **101***a*, **102***a*, **103***a*, **104***a* of the injectors #**1** to #**4** on one end, while the other ends are connected from the injector side of the external wiring connecting terminal row (from below as viewed in FIG. **29**) to the external wiring independent connecting terminals **151** to **154**.

The common wire **121** is connected to the common connecting terminal **110***b* of the injector #**1** on one end, while the other end is connected from the side opposite to the injector side of the external wiring connecting terminal row (from above as viewed in FIG. **29**) to the external wiring common connecting terminal **158**. Specifically, the common wire **121** takes a detour from above the connecting terminals **151**, **152** or from the side opposite to the injector side. The common wires **122**, **123** are connected to the common connecting terminals **102***b*, **103***b* of the injectors #**2** and #**3** on one end, while the other ends are connected from the injector side of the external wiring connecting terminal row (from below as viewed in FIG. **29**) to the common connecting terminal **158**. The common wire **124** is connected to the common connecting terminal **104***b* of the injector #**4** on one end, while the other end is connected from the side opposite to the injector side of the external wiring connecting terminal row to the common connecting terminal **158**. Specifically, the common wire **124** takes a detour from above the connecting terminals **153**, **154** or from the side opposite to the injector side.

Also in the fourth embodiment, the wires **111** to **114**, **121** to **124** can be installed without crossing each other between the independent connecting terminals **101***a*, **102***a*, **103***a*, **104***a* and the common connecting terminals **101***b*, **102***b*, **103***b*, **104***b* of the injectors #**1** to #**4**, and the independent connecting terminals **151** to **154** and the common connecting terminal **158** of the external wiring connector **150**.

The independent wires **111** to **114** and the common wires **121** to **124** are installed using a method of installing the wires that will be explained in further detail below. Similar to the second embodiment, this wiring method includes the steps of routing the wires, connecting the wires and removing or cutting out unnecessary or surplus wires.

In the routing step, as shown in FIG. **30**, a single wire **110** is routed along a wire routing path through each of wiring guides (not shown) of the connector block body, the independent connecting terminals **101***a*, **102***a*, **103***a*, **104***a* and the common connecting terminals **101***b*, **102***b*, **103***b*, **104***b* of the injectors #**1** to #**4**, the independent connecting terminals **151** to **154** and the common connecting terminal **158** of the external wiring connector **150**, and eight auxiliary guides **181** to **188**. The wire **110** preferably may be installed in a single continuous operation along the wire routing path. Similar to the second embodiment, a known automatic wiring machine can be used for this wire routing operation. In FIG. **30**, portions of the wire **110** that form the independent wires **111** to **114** are shown by fine lines and portions of the wire **110** that form the common wires **121** to **124** are shown by heavy lines. The wire portions shown by fine lines and heavy lines are necessary wire portions. The remaining wire portions shown by dotted lines are unnecessary or surplus wire portions **110***a*.

As shown in FIG. **30**, generally rod-like auxiliary guides **181** to **188** are positioned around the connector block body **130**. Similar to the second embodiment, the auxiliary guides **181** to **188** are vertically disposed on a work support base of the automatic wiring machine (not shown). The auxiliary guide **181** is disposed below the common connecting terminal **158**. The auxiliary guide **182** is disposed below the injector #**4**. The third auxiliary guide **183** is disposed above the independent connecting terminals **153**, **154**. The auxiliary guide **184** is disposed below the injector #**3**. The auxiliary guide **185** is disposed below the injector #**1**. The auxiliary guide **186** is disposed above the independent connecting terminals **151**, **152**. The auxiliary guide **187** is disposed below the injector #**2**. The auxiliary guide **188** is disposed above the common connecting terminal **158**.

As shown in FIG. **30**, the automatic wiring machine routes the wire **110** from a starting point S of the auxiliary guide **181** back to an ending point E of the auxiliary guide **181**. The wire **110** may pass through the external wiring common connecting terminal **158**, the common connecting terminal **104***b* of the injector #**4**, the auxiliary guide **182**, the independent connecting terminal **104***a* of the injector #**4**, the independent connecting terminal **154**, the auxiliary guide **183**, the independent connecting terminal **153**, the independent connecting terminal **103***a* of the injector #**3**, the auxiliary guide **184**, the common connecting terminal **103***b* of the injector #**3**, the common connecting terminal **158**, the common connecting terminal **101***b* of the injector #**1**, the auxiliary guide **185**, the independent connecting terminal **101***a* of the injector #**1**, the independent connecting terminal **151**, the auxiliary guide **186**, the independent connecting terminal **152**, the independent connecting terminal **102***a* of the injector #**2**, the auxiliary guide **187**, the common connecting terminal **102***b* of the injector #**2**, the common connecting terminal **158** and the auxiliary guide **188** in this order. Similar to the second embodiment, the wire **10** is installed using a predetermined tension while being wound around or hooked on the wire guides (not shown).

Subsequently, in the wire connecting step, the wire **110** is connected to the connecting terminals **101***a*, **102***a*, **103***a*, **104***a*, **101***b*, **102***b*, **103***b*, **104***b*, **151** to **154**, **158**, for example, by soldering, ultrasonic deposition, resistance welding or similar fastening processes.

Subsequently, in the wire removal step, the unnecessary or surplus wire portions **110***a* (see FIG. **30**) are removed or cut out by a cutting device in the automatic wiring machine (not shown), which unnecessary or surplus wire portions **110***a* are portions of the wire **110** other than the necessary wire portions (the independent wires **111** to **114** and the common wires **121** to **124**) that are connected between the independent connecting terminals **101***a*, **102***a*, **103***a*, **104***a* and the common connecting terminals **101***b*, **102***b*, **103***b*, **104***b* of the injectors #**1** to #**4** and the independent connecting terminals **151** to **154** and the common connecting terminal **158** of the external wiring connector **150**. Thus, the wire installation of the wires **111** to **114**, **121** to **124** with respect to the connector block body **130** is completed.

Fifth Representative Embodiment

A fifth representative embodiment will now be explained in further detail with reference to the wiring diagram of FIG. **31** and the wire routing diagram of FIG. **32**. The fifth representative embodiment is a fuel delivery pipe for an in-line six-cylinder engine and has six injectors #**1** to #**6** arranged from the left to the right in this order. In the injectors #**1**, #**4**, #**5**, the independent connecting terminals **101***a*, **104***a*, **105***a* are disposed on the right, while the common connecting terminals **101***b*, **104***b*, **105***b* are disposed on the left. In the injectors #**2**, #**3**, #**6**, the independent connecting terminals **102***a*, **103***a*, **106***a* are disposed on the left, while the common connecting terminals **102***b*, **103***b*, **106***b* are disposed on the right.

In the external wiring connector **150**, seven external wiring connecting terminals **151** to **156**, **158** are disposed along the external wiring connecting terminal row that is generally parallel to the injector row. With the exception of the centrally located terminal **158**, connecting terminals **151** to **156** are used as external wiring independent connecting terminals for supplying driving signals to the injectors #**1** to #**6**. The centrally located connecting terminal **158** is used as an external wiring common connecting terminal.

The independent wires **111** to **116** are connected to the independent connecting terminals **101***a*, **102***a*, **103***a*, **104***a*, **105***a*, **106***a* of the injectors #**1** to #**6** on one end, while the other ends are connected from the injector side of the external wiring connecting terminal row (from below as viewed in FIG. **31**) to the external wiring independent connecting terminals **151** to **156**.

The common wire **121** is connected to the common connecting terminal **101***b* of the injector #**1** on one end, while the other end is connected from the side opposite to the injector side of the external wiring connecting terminal row (from above as viewed in FIG. **32**) to the external wiring common connecting terminal **158**. Specifically, the common wire **121** takes a detour from above the independent connecting terminals **151** to **153** or from the side opposite to the injector side.

The common wire **122** is connected to the common connecting terminal **102***b* of the injector #**2** on one end, while the other end is connected from the side opposite to the injector side of the external wiring connecting terminal row (from above as viewed in FIG. **32**) to the external wiring common connecting terminal **158**. Specifically, the common wire **122** takes a detour from above the connecting terminal **153** or from the side opposite to the injector side.

The common wires **123**, **124** are connected to the common connecting terminal **103***b*, **104***b* of the injectors #**3**, #**4** on one end, while the other ends are connected from the injector side of the external wiring connecting terminal row (from below as viewed in FIG. **32**) to the common connecting terminal **158**. The common wires **123** and **124** may he integrated into one wire with respect to the common connecting terminal **158** and connected to the terminal **158**.

The common wire **125** is connected to the common connecting terminal **105***b* of the injector #**5** on one end, while the other end is connected from the side opposite to the injector side of the external wiring connecting terminal row (from above as viewed in FIG. **32**) to the external wiring common connecting terminal **158**. Specifically, the common wire **125** takes a detour from above the connecting terminal **154** or from the side opposite to the injector side.

The common wire **126** is connected to the common connecting terminal **106***b* of the injector #**6** on one end, while the other end is connected from the side opposite to the injector side of the external wiring connecting terminal row (from above as viewed in FIG. **32**) to the external wiring common connecting terminal **158**. Specifically, the common wire **126** takes a detour from above the connecting terminals **154** to **156** or from the side opposite to the injector side. The common wires **125** and **126** may be integrated into one wire with respect to the common connecting terminal **158** and connected to the terminal **158**.

Also, in the fifth embodiment, the wires **111** to **116**, **121** to **126** can be installed without crossing each other between the independent connecting terminals **101***a*, **102***a*, **103***a*, **104***a*, **105***a*, **106***a* and the common connecting terminals **101***b*, **102***b*, **103***b*, **104***b*, **105***b*, **106***b* of the injectors #**1** to #**6**, and the independent connecting terminals **151** to **156** and the common connecting terminal **158** of the external wiring connector **150**.

The independent wires **111** to **116** and the common wires **121** to **126** are installed using a method of installing the wires that will be explained in further detail below. Similar to the second and fourth embodiments, this wiring method includes the steps of routing the wires, connecting the wires and removing or cutting out unnecessary or surplus wires.

In the routing step, as shown in FIG. **32**, a wire **110** is routed along a wire routing path through each of wiring guides (not shown) of the connector block body, the independent connecting terminals **101***a*, **102***a*, **103***a*, **104***a*, **105***a*, **106***a* and the common connecting terminals **101***b*, **102***b*, **103***b*, **104***b*, **105***b*, **106***b* of the injectors #**1** to #**6**, the independent connecting terminals **151** to **156** and the common connecting terminal **158** of the external wiring connector **150**, and twelve auxiliary guides **181** to **192**. The wire **110** can be installed in a single continuous operation along the wire routing path. A known automatic wiring machine can be used for this wire routing operation. In FIG. **32**, portions of the wire **110** that form the independent wires **111** to **116** are shown by the lines and portions of the wire **110** that form the common wires **121** to **126** are shown by heavy lines. The wire portions shown by fine lines and heavy lines are necessary wire portions. The remaining wire portions shown by dotted lines are unnecessary or surplus wire portions **110***a*.

As shown in FIG. **32**, generally rod-like auxiliary guides **181** to **192** are positioned around the connector block body **130**. Similar to the second and fourth embodiments, the auxiliary guides **181** to **192** are vertically disposed on a work support base of the automatic wiring machine (not shown). The auxiliary guide **181** is disposed to the lower right of the common connecting terminal **158**. The auxiliary guide **182** is disposed below the injector #**6**. The auxiliary guide **183** is disposed above the independent connecting terminals **155**, **156**. The auxiliary guide **184** is disposed below the injector #**5**. The auxiliary guide **185** is disposed below the injector #**4**. The auxiliary guide **186** is disposed above the independent connecting terminal **154**. The auxiliary guide **187** is disposed to the lower left of the common connecting terminal **158**. The auxiliary guide **188** is disposed below the injector #**1**. The auxiliary guide **189** is disposed above the independent connecting terminals **151**, **152**. The auxiliary guide **190** is disposed below the injector #**2**. The auxiliary guide **191** is disposed below the injector #**3**. The auxiliary guide **192** is disposed above the independent connecting terminal **153**.

As shown in FIG. **32**, the wire **110** is routed from a starting point S of the auxiliary guide **181** back to an ending point E of the auxiliary guide **181**, passing through the external wiring common connecting terminal **158**, the common connecting terminal **106***b* of the injector #**6**, the auxiliary guide **182**, the independent connecting terminal **106***a* of the injector #**6**, the independent connecting terminal **156**, the auxiliary guide **183**, the independent connecting terminal **155**, the independent connecting terminal **105***a* of the injector #**5**, the auxiliary guide **184**, the common connecting terminal **105***b* of the injector #**5**, the common connecting terminal **158**, the common connecting terminal **104***b* of the injector #**4**, the auxiliary guide **185**, the independent connecting terminal **104***a* of the injector #**4**, the independent connecting terminal **154**, the auxiliary guide **186**, the auxiliary guide **187**, the common connecting terminal **158**, the common connecting terminal **101***b* of the injector #**1**, the auxiliary guide **188**, the independent connecting terminal **101***a* of the injector #**1**, the independent connecting terminal **151**, the auxiliary guide **189**, the independent connecting terminal **152**, the independent connecting terminal **102***a* of the injector #**2**, the auxiliary guide **190**, the common connecting terminal **102***b* of the injector #**2**, the common connecting terminal **158**, the common connecting terminal **103***b* of the injector #**3**, the auxiliary guide **191**, the independent connecting terminal **103***a* of the injector #**3**, the independent connecting terminal **153** and the auxiliary guide **192** in this order. During the wire installation process, the wire **110** is installed using a predetermined tension while being wound around or hooked on the wire guides (not shown).

Subsequently, in the wire connecting step, the wire **110** is connected to the connecting terminals **101***a*, **102***a*, **103***a*, **104***a*, **105***a*, **106***a*, **101***b*, **102***b*, **103***b*, **104***b*, **105***b*, **106***b*, **151** to **156**, **158** by soldering, ultrasonic deposition, resistance welding or similar processes.

Subsequently, in the wire removal step, the unnecessary or surplus wire portions **110***a* are removed or cut out by a cutting device in the automatic wiring machine (not shown), which unnecessary or surplus wire portions **110***a* are portions of the wire **110** other than the necessary wire portions (the independent wires **111** to **116** and the common wires **121** to **126**) that are connected between the independent connecting terminals **101***a*, **102***a*, **103***a*, **104***a*, **105***a*, **106***a* and the common connecting terminals **101***b*, **102***b*, **103***b*, **104***b*, **105***b*, **106***b* of the injectors #**1** to #**6** and the independent connecting terminals **151** to **156** and the common connecting terminal **158** of the external wiring connector **150**. Thus, the wire installation of the wires **111** to **116**, **121** to **126** with respect to the connector block body **130** is completed. The main body, wire distribution enclosure and ports for receiving the injector for each of the representative embodiments may preferably be integrally formed using injection molding techniques that are well known in the art, for example, in Japanese Patent Publication No. 4-263913.

The present teachings are not limited to the constructions that have been described as the representative embodiments, but rather, may be added to, changed, replaced with alternatives or otherwise modified without departing from the spirit and scope of the invention. For example, the present teachings may also be applied to engines having a different number of cylinders. The wire guides may also be fixed to the connector block body, for example, by a nail. The number, location and shape of the wire guides and the auxiliary guides are not limited. A plurality of wiring guides may be provided as one set and the wires may be wound around the wire guides more than one turn. The wire guides around which the wires are wound include wire guides that do not change the wiring direction of the wires. The auxiliary guides are not required if not necessary. Wiring guides may be provided in the connector block body as a substitute for the auxiliary guides. The injectors are not required to be arranged in a row. The connecting terminals of the connector connecting portions are not required to be arranged in a row. Instead of mounting a cover to cover the wire distribution enclosure **20**, the fuel delivery pipe may also be completed by filling a potting resin in the wire distribution enclosure **20** of the main body **10**. The wires are not required to be laid in generally the same plane as long as the wires do not cross each other. Further, although this invention has been

described with respect to the fuel delivery pipe incorporating a connector block body, it may also be constructed as a connector block for injectors. Finally, fuel delivery pipes may be modified according to the teachings of U.S. Pat. No. 5,735,247, which is hereby incorporated by reference in its entirely.

What is claimed is:

1. An apparatus adapted to deliver fuel from a fuel supply to a plurality of fuel injectors, comprising:

a main body having a fuel passage defined therein,

a wire distribution enclosure integrally disposed on the main body and having a plurality of wiring guides, wherein the wire distribution enclosure is substantially hollow,

an external wiring connector disposed on the main body and having a plurality of connecting terminals,

a plurality of ports disposed on the main body and adapted to receive fuel injectors, the ports each having connecting terminals and

a plurality of wires wound around the wiring guides within the wire distribution enclosure and coupling the connecting terminals of the external wiring connector to the respective port connecting terminals.

2. An apparatus as set forth in claim **1**, wherein the wires are hooked on the wire guides.

3. An apparatus as set forth in claim **1**, wherein the wire guides are disposed in a position to change the routing direction of the wires.

4. An apparatus as set forth in claim **1**, wherein each of the wire guides has a wire retainer.

5. An apparatus as set forth in claim **1**, wherein each of the wires passes across at least one of the connecting terminals.

6. An apparatus as set forth in claim **1**, further comprising at least one partition that separates the wire distribution enclosure into at least two sections.

7. An apparatus as set forth in claim **6**, wherein the wires are separately installed in each of the sections of the wire distribution enclosure separated by the at least one partition.

8. An apparatus as set forth in claim **1**, wherein the connecting terminals of the external wiring connector are press-fitted in the connector.

9. An apparatus as set forth in claim **1**, wherein a surrounding wall is provided to enclose the wire distribution enclosure.

10. An apparatus as set forth in claim **9**, wherein the connecting terminals of the injectors extend through the surrounding wall.

11. An apparatus as set forth in claim **9**, wherein the surrounding wall has grooves for receiving the wires across the surrounding wall.

12. An apparatus as set forth in claim **1**, wherein the wires do not cross each other.

13. An apparatus as set forth in claim **12**, wherein:

the connecting terminals of the external wiring connector comprise one external wiring common connecting terminal and a plurality of external wiring independent connecting terminals, the number of external wiring independent connecting terminals corresponding to the number of injectors,

the connecting terminals of each of the injectors comprise an injector independent connecting terminal and an injector common connecting terminal,

each of the wires connected to the injector independent connecting terminals is connected to an associated one of the external wiring independent connecting terminals, and

at least one of the wires connected to the common connecting terminals is connected from the injector side to the external wiring common connecting terminal and the other wires are routed from the side opposite to the injector side and connected to the external wiring common connecting terminal.

14. An apparatus as set forth in claim **1**, further comprising a surrounding wall that encloses the wire distribution enclosure, a wire retainer disposed on each wire guide and at least one partition that separates the wire distribution enclosure into sections, wherein the wires are separately installed in each of the sections of the wire distribution enclosure and the wires do not cross each other.

15. An apparatus as set forth in claim **14**, wherein the connecting terminals of the injectors extend through the surrounding wall.

16. An apparatus as set forth in claim **15**, wherein the wire guides are disposed in a position to change the routing direction of the wires.

17. An apparatus as set forth in claim **16**, wherein:

the connecting terminals of the external wiring connector comprise one external wiring common connecting terminal and a plurality of external wiring independent connecting terminals, the number of external wiring independent connecting terminals corresponding to the number of injectors,

the connecting terminals of each of the injectors comprise an injector independent connecting terminal and an injector common connecting terminal,

each of the wires connected to the injector independent connecting terminals is connected to an associated one of the external wiring independent connecting terminals, and

at least one of the wires connected to the common connecting terminals is connected from the injector side to the external wiring common connecting terminal and the other wires are routed from the side opposite to the injector side and connected to the external wiring common connecting terminal.

18. A method of installing a plurality of electrical connections in a fuel delivery pipe having a plurality of injector connecting terminals, an external wiring connector having a plurality of connecting terminals, a main body having a wire distribution enclosure comprising a plurality of wiring guides and a plurality of wires disposed within the wire distribution enclosure that connect injector connecting terminals to respective connecting terminals of the external wiring connector, the method comprising:

routing a single wire along a wire routing path around the plurality of wiring guides,

connecting the wire to the respective connecting terminals and

removing portions of the wire that do not provide appropriate connections between the injector connecting terminals and the respective connecting terminals of the external wiring connector, thereby creating the plurality of wires.

19. A method as set forth in claim **18**, wherein auxiliary guides are disposed around the fuel delivery pipe and the wire is routed around the auxiliary guides and the wire guides in the wire routing step.

20. A method as in claim **19**, wherein the wire routing step is performed in a single continuous operation.

21. A method of installing a plurality of electrical connections in a fuel delivery pipe having a plurality of injector ports, each injector port having one injector independent

connecting terminal and one injector common connecting terminal, an external wiring connector having one external wiring common connecting terminal and a plurality of external wiring independent connecting terminals that correspond in number to the number of injector ports, a plurality of wires that connect the injector independent connecting terminal and the injector common connecting terminal of each of the injectors to the external wiring common connecting terminal and the external wiring independent connecting terminals of the external wiring connector, and wiring guides, the method comprising:

routing a single wire along a wire routing path around the plurality of wiring guides, through the injector independent connecting terminal and the injector common connecting terminal of each of the injectors, and the external wiring common connecting terminal and the external wiring independent connecting terminals of the external wiring connector,

connecting the wire to the connecting terminals and

removing unnecessary portions of the wire, thereby creating the plurality of wires.

22. A method as set forth in claim **21**, wherein auxiliary guides are disposed around the fuel delivery pipe and the wire is routed around the auxiliary guides and the wire guides, such that the wire passes across at least one of the connecting terminals of the injectors and the connecting terminals of the external wiring connector in the wire routing step.

23. A method as in claim **22**, wherein the wire routing step is performed in a single continuous operation.

24. An apparatus adapted to deliver fuel from a fuel supply to a plurality of fuel injectors, comprising:

a main body having a fuel passage defined therein,

a wire distribution enclosure integrally disposed on the main body and having a plurality of wiring guides, wherein the wiring guides are disposed in a position to change the routing direction of the wires, and wherein the wire distribution enclosure is substantially, hollow,

an external wiring connector disposed on the main body and having a plurality of connecting terminals,

a plurality of ports disposed on the main body and adapted to receive fuel injectors, the ports each having connecting terminals and

a plurality of wires disposed around the wiring guides within the wire distribution enclosure and coupling the connecting terminals of the external wiring connector to the respective port connecting terminals.

25. An apparatus adapted to deliver fuel from a fuel supply to a plurality of fuel injectors, comprising:

a main body having a fuel passage defined therein,

a wire distribution enclosure integrally disposed on the main body and having a plurality of wiring guides, wherein the wiring guides have a wall-like configuration and partition the wire distribution enclosure into sections, and wherein the wire distribution enclosure is substantially hollow,

an external wiring connector disposed on the main body and having a plurality of connecting terminals,

a plurality of ports disposed on the main body and adapted to receive fuel injectors, the ports each having connecting terminals and

a plurality of wires disposed around the wiring guides within the wire distribution enclosure and coupling the connecting terminals of the external wiring connector to the respective port connecting terminals.

26. An apparatus adapted to deliver fuel from a fuel supply to a plurality of fuel injectors, comprising:

a main body having a fuel passage defined therein,

a wire distribution enclosure integrally disposed on the main body and having a plurality of wiring guides, wherein the wire distribution enclosure is substantially hollow,

a surrounding wall having grooves for receiving the wires across the surrounding wall is provided to enclose the wire distribution enclosure,

an external wiring connector disposed on the main body and having a plurality of connecting terminals,

a plurality of ports disposed on the main body and adapted to receive fuel injectors, the ports each having connecting terminals and

a plurality of wires disposed around the wiring guides within the wire distribution enclosure and coupling the connecting terminals of the external wiring connector to the respective port connecting terminals.

27. An apparatus adapted to deliver fuel from a fuel supply to a plurality of fuel injectors, comprising:

a main body having a fuel passage defined therein,

a wire distribution enclosure integrally disposed on the main body and having a plurality of wiring guides, wherein the wire distribution enclosure is substantially hollow,

an external wiring connector disposed on the main body and having a plurality of connecting terminals,

a plurality of ports disposed on the main body and adapted to receive fuel injectors, the ports each having connecting terminals and

a plurality of wires disposed around the wiring guides within the wire distribution enclosure and coupling the connecting terminals of the external wiring connector to the respective port connecting terminals, and the wires do not cross each other, and

wherein the plurality of connecting terminals comprise one external wiring common connecting terminal and a plurality of external wiring independent connecting terminals, the number of external wiring independent connecting terminals corresponding to the number of fuel injectors,

the connecting terminals of each of the injectors comprise an injector independent connecting terminal and an injector common connecting terminal,

each of the wires connected to the injector independent connecting terminals is connected to an associated one of the external wiring independent connecting terminals, and

at least one of the wires connected to the common connecting terminals is connected from the injector side to the external wiring common connecting terminal and the other wires are routed from the side opposite to the injector side and connected to the external wiring common connecting terminal.

28. An apparatus adapted to deliver fuel from a fuel supply to a plurality of fuel injectors, comprising:

a main body having a fuel passage defined therein,

a wire distribution enclosure integrally disposed on the main body and having a plurality of wiring guides, wherein the wire distribution enclosure is substantially hollow,

an external wiring connector disposed on the main body and having a plurality of connecting terminals,

a plurality of ports disposed on the main body and adapted to receive fuel injectors, the ports each having connecting terminals and

a plurality of wires disposed around the wiring guides within the wire distribution enclosure and coupling the connecting terminals of the external wiring connector to the respective port connecting terminals, and

a surrounding wall that encloses the wire distribution enclosure and a wire retainer disposed on each wiring guide, wherein the wiring guides partition the wire distribution enclosure into section, the wires are separately installed in each of the sections of the wire distribution enclosure and the wires do not cross each other.

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